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Vol. 14, No. 8
April 30, 1989

Energy Research Abstracts

Abstracts 14123-16911

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Vol. 14, No. 8
ISSN: 0160-3604
CODEN: ERABD
April 30, 1989

ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through the Energy Data Information System (EDIS) maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 13-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

Information in *ERA* is available for on-line searching as part of the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

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ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Managing Editor, Audrey B. Smith
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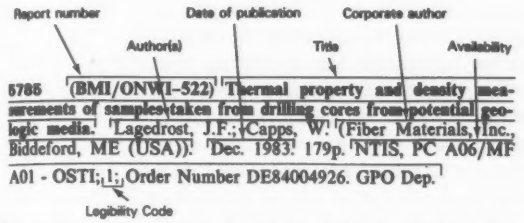
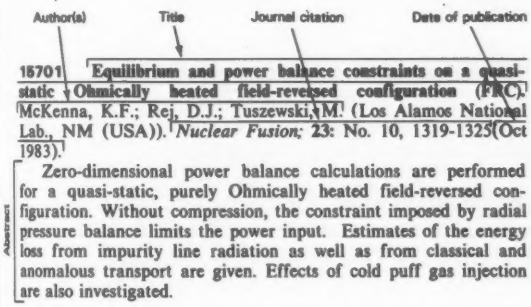
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Author(s)
Date of publication
Corporate author
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01 - OSTI; 1; Order Number DE84004926. GPO Dep.
Legibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

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DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	**9:5785**	NTIS, PC A09/MF A01. OSTI Order Number DE84004926, Distribution Category MN-70

INFORMATION SOURCES

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

Canada
Denmark
Finland
France
Federal Republic of Germany
Italy
Japan
The Netherlands
Norway
Spain
Sweden
United Kingdom
United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 75 countries and 14 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, OSTI both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a data base for on-line retrieval. The data base serves as well for the production of numerous OSTI publications.

SUBJECT CONTENTS (NUMERICAL LISTING)

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14123 **(CMRC—80/11-T) Coal cleaning by counter-current fluidized cascade.** (Coal Mining Research Centre, Edmonton, Alberta (Canada)). 1980. 23p. (CE—02233). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The counter-current fluidized cascade is a novel and potentially very efficient pneumatic gracity separation device. Data are presented on beneficiation of 20 x 0.8 mm coal mixed with limestone or limestone-hematite fluidizing medium, and on 0.6 x 0.1 mm coal without fluidizing medium. Addition of hematite to the fluidizing medium is reuqired to raise the effective separation specific gravity to an acceptable throughput rates per unit width of separator are achievable separation efficiencies with the finer coal fractions. A comparison of partition curves for the fluidized cascade with those of conventional hydraulic commerical separators showed that the cascade's performance is equivalent to that of a heavy medium cyclone in the size range 20 x 6 mm, and is comparable to that of a Baum jig in the size range 6 x 0.8 mm. The coal used was an Alberta sub-bituminous type, which would normally produce a significant volume of ultra fine high ash clay particles during wet cleaning, with its attendant tailings disposal problems; however there was no evidence of clay degradation in the fluidized cascade, and should any fine clay particles be elutriated their capture in a baghouse or cyclone and eventual disposal would not present a significant problem. 5 refs., 4 figs., 6 tabs.

14124 **(DOE/FE—0113) Public meeting on increasing western participation in the 1989 Clean Coal Technology Solicitation, Cheyenne, WY, December 1988: Summary proceedings.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). 1988. 118p. (CONF-881250—Summ.). NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005512/JAW.

From DOE public meeting on increasing western participation in the 1989 clean coal technology solicitation; Cheyenne, WY, USA (2 Dec 1988).

The purpose of the DOE Public Meeting in Cheyenne, Wyoming on December 2, 1988 was to seek suggestions from the public for possible means to increase Western-project participation in the third solicitation, which will be issued by May 1, 1989. This report contains remarks of the various speakers, summaries of the discussion workshops, background Clean Coal Technology Solicitation materials, and the conference registration list. 17 figs.

14125 **(DOE/FE—0115-6) Coal preparation program: Fiscal year 1989 summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006809/JAW.

Program plans of the Office of Coal Technology in coal preparation are briefly described. Included is a technology description, status, market applications, program strategy and management. Chemical and biological beneficiation are addressed. CBS

14126 **(DOE/PC/88917—1) A new approach in ultrapurification of coal by selective flocculation: Quarterly report.** Moudgil, B.M. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering). Dec 1988. Contract FG22-88PC88917. 10p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006755/JAW.

The coal and coal refuse samples were received from Pittsburgh-Bruceton mine for the studies in ultrapurification of coal by selective flocculation. The comminution and sampling of coal is completed and that of coal refuse is in progress. The ash analysis of coal samples indicated a mineral matter content of 4.2%, whereas the EDAX analysis of the coal samples shows Al, Ca, Fe, P, S, and Si as the elemental constituents of the mineral matter. The quantitative analysis of the mineral fraction of the coal is being carried out. Preliminary flocculation experiments using PEO and polyacrylamide type flocculants are in progress. 2 refs., 5 figs., 1 tab.

14127 **(EPRI-CS—5644-Vol.2) Laboratory guidelines and procedures for coal analysis: Volume 2, Determining coal size distribution by wet screening.** Parsons, T.H.; Glessner, D.M. (Electric Power Research Inst., Palo Alto, CA (USA); Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA); Pennsylvania Electric Co., Johnstown (USA); New York State Electric and Gas Corp., Binghamton (USA); Geochemical Testing, Inc., Homer City, PA (USA). Homer City Coal Lab.). Jan 1989. 116p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006848/JAW.

A new laboratory screening procedure for determining coal size distribution--the wet-scalp method--combines the speed of dry screening with the accuracy of wet screening. Analysis of wet-scalping data showed the new procedure yielded estimates as accurate as wet screening methods, but required only two-thirds the time and resulted in cost savings of up to 42% per test. 14 refs., 28 figs., 9 tabs.

14128 **(IS-M—604) Stabilization of coal cleaning waste.** Gokhale, A.J.; Burnet, G. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Chemical Engineering). 1987. Contract W-7405-ENG-82. 15p. (CONF-8704108—2). NTIS, PC A03 - OSTI. Order Number DE89005997/JAW.

From Waste management for the energy industries conference; Grand Rapids, ND, USA (29 Apr 1987).

Coal cleaning wastes are ground, granulated and sintered to form vitreous, impervious granules capable of disposal without dusting, leaching or smoldering. The process utilizes the energy inherently present in the wastes. Characterization and grinding of the wastes, the formation and testing of green granules for strength and durability, the firing of the granules in a large tube furnace to approximate sintering in a traveling grate furnace, and evaluation of the sintered granules by means of standard leaching and freeze-thaw tests are discussed. 10 refs., 6 figs., 6 tabs.

14129 **(OY/PSTL-TIED—50) Climatological qualification of peat production and possibilities to extend the production season.** Leiviskae, V. (Oulu Univ. (Finland). Research Inst. of Northern Finland). Mar 1988. 67p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756289/JAW.

This report deals with frost and evaporation on the basis of peat production and also possibilities to extend the production season by methods based on natural drying. The milled peat production season is defined by frost and temperature conditions. Theoretical production/ha (m/sup 3//ha) was counted on the basis of potential evaporation of the production season. Mechanical dewa-

tering and harvesting of freezed peat plates and harvesting of molten peat below the frozen layer were tested as methods for extension of production season. Due to the natural condition the possibilities of fuel peat production are deteriorated when passing from south to north. The length of production season in the Central Lapland is more than a month shorter than in Western and Central Finland. Due to variation of the length of production season the theoretical production/ha is 35-45% smaller in Central Lapland than in Western and Middle Finland. In June and July, which are the most important months in peat production, the difference is 15-20%. The production season can be extended 5-6 months by using mechanical dewatering and harvesting below the frozen layer. Frozen peat plates can be harvested during 4-6 winter months. The mechanical dewatering based on the batch method is not suitable for mass production of fuel peat because of its low productivity. Theoretical production/ha is varying in between 12 000 m/sup 3//ha in Southern Finlan and approx. 20 000 m/sup 3//ha in Central Lapland. The production in harvesting the molten peat below the frozen layer is analogously 2000-3000 m/sup 3//ha. The drying of peat and peat harvesting techniques are the main problems in large scale production of peat plates and in production of peat from the molten layer.

14130 **Sulfur removal and comminution of carbonaceous material.** Narain, N.K.; Ruether, J.A.; Smith, D.N. (to Dept. of Energy, Washington, DC). US Patent 4,775,387. 4 Oct 1988. Filed date 7 Oct 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described of removing sulfur during the comminution of carbonaceous material comprising: forming a slurry including the carbonaceous material in aqueous, alkali-containing solution, increasing the temperature and pressure of the slurry to at least the critical temperature and pressure of steam; abruptly reducing the pressure to explosively comminute the carbonaceous material and release sulfur containing gases; separating the alkali from the comminuted carbonaceous material.

14131 **Relation of slag viscosity and surface tension to sintering potential.** Miller, S.F. (The Pennsylvania State Univ., Dept. of Material Sciences, Fuel Science, University Park, PA (US)); Kalmanovitch, D.P. (Univ. of North Dakota Energy and Mineral Research Center, Box 8213, University Station, Grand Forks, ND (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 42-49(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The purpose of this paper is to discuss the relative effect of viscosity and surface tension on sintering potential or agglomeration in coal utilization systems. Of specific interest is the effect of composition and atmosphere on viscosity and surface tension.

14132 **Behavior of ash-forming mineral matter in coal during chemical cleaning with molten caustic.** Kaushik, S.M.; Norton, G.A.; Markuszewski, R. (Ames Lab., Iowa State Univ., Ames, IA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 18-27(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Coal-derived mineral matter, obtained by low-temperature ashing of Kentucky No. 11 coal, as well as mineral-grade samples of quartz, illite, kaolinite, and pyrite, were treated with various ratios of molten caustic (NaOh, KOH, and 1:1 NaOH-KOH mixtures) at 370°C for 1-2 hours to study the nature of reaction products obtained under the conditions of chemical cleaning of coal by the molten caustic leaching (MCL) process. Under these conditions, most of the reactions of minerals with caustic were very rapid, being complete in less than 10 minutes. The reaction products were characterized by x-ray diffraction, thermogravimetry analysis, atomic absorption spectrophotometry, and chemical analysis. The nature of these products was related to the stoichiometry of the reaction and was useful in explaining the process chemistry and in developing regeneration schemes for the spent caustic.

14133 **Evaluation of coal-mineral association and coal cleanability by using SEM-based automated image analysis.** Straszheim, W.E.; Younkin, K.A.; Markuszewski, R. (Ames Lab., Iowa State Univ., Ames, IA (US)); Smith, F.J. (AMAX Research and Development Center, Golden, CO (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 64-72(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A technique employing SEM-based automated image analysis (AIA) has been developed for assessing the association of mineral particles with coal, and thus the cleanability of that coal, when the characteristics of the separation process are known. Data resulting from AIA include the mineral distribution by particle size, mineral phase, and extent of association with coal. This AIA technique was applied to samples of -325 mesh (-44 μm) coal from the Indiana No. 3, Upper Freeport, and Sunnyside (UT) seams. The coals were subjected to cleaning by float-sink separations at 1.3, 1.4, 1.6, and 1.9 specific gravity and by froth flotation. For the three coals, the float-sink procedure at a given specific gravity produced different amounts of clean coal, but with similar ash content. Froth flotation removed much less ash, yielding a product ash content of —8% for the Upper Freeport coal, regardless of recovery, while reducing the ash content to less than 5% for the other two coals. The AIA results documented significantly more association of minerals with the Upper Freeport coal, which thus led to the poor ash reduction.

14134 **A granulation/sintering method for the codisposal of solid residues from coal conversion processes.** Burnet, G.; Gokhale, A.J.; Meisinger, R.F. (Ames Lab., U.S.D.O.E. and Dept. of Chemical Engineering, Iowa State Univ., Ames, IA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 103-111(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A stabilization process for coal cleaning and coal combustion-related wastes has been developed that uses the energy derived from the fuel contained in the coal cleaning waste. The wastes are pulverized, when necessary, formed into granules in a rotary pan agglomerator, and then fired to a sintering temperature. The resulting readily disposable product consists of rock-hard granules that are highly resistant to environmental degradation. The green (nondried and nonfired) granules satisfy durability tests that measure the capability to be handled and stored. The sintered granules meet requirements of the standard ASTM and EP leaching tests and a freeze-thaw cycle test. The strength of the sintered granules compares favorably with the strength of natural aggregates. The process has been applied to coal cleaning refuse alone and to refuse/fly ash and refuse/FGD sludge mixtures.

14135 **Beneficiation of a bituminous coal and a lignite coal by agglomeration using novel binding oils.** Timpe, R.C.; Knudson, C.L.; Mack, P. (Univ. of North Dakota Energy and Mineral Research Center, P.O. Box 8213, University Station, Grand Forks, ND (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 352-358(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Illinois #6 and both as received and hot water dried Zap (Indianhead) North Dakota lignite were agglomerated with Mandan refinery decant oil containing either p-xylene or deodorized rectisol naphtha from the Great Plains Gasification Plant. The effectiveness of each of the binding oils on agglomeration was determined from ash reduction and organic recovery as a function of mixing speed, mixing time, particle size, and oil-to-coal ratio. Results indicated that, although the ash reduction was significant in the Mandan decant/rectisol naphtha binder for both coals, greater reduction was achieved with the Mandan decant/p-xylene. Higher mixing speeds, longer mixing times, smaller particle size, and binder to coal ratio of 0.35 gave the greatest ash reductions. Agglomeration time was shortened substantially when either p-xylene or rectisol naphtha was added to the Mandan decant in place of using Mandan decant alone as binder.

14136 **Kinetics of vacuum drying and rehydration of Illinois #6 coal samples. Implications for pore structure.** Vorres, K.S.; Kolman, R.; Griswold, T. (Chemistry Div., Building 211, Argonne National Lab., Argonne, IL (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 333-342(Jun 1988).

The kinetics of vacuum dehydration and rehydration in nitrogen near room temperature have been studied with Argonne Premium Coal Samples. A block, -20 mesh and -100 mesh material were used. Three types of kinetic behavior were observed in dehydration and rehydration. These included a first order mass change, a combination of some or all of an initial linear, parabolic and final linear (LPL) segments, and a behavior which can be plotted to appear similar to an adsorption isotherm. The mechanisms involved in the linear-parabolic-linear sequence are tentatively assumed to be loss from macro pores, bulk diffusion, and loss of "bonded water" respectively. The rates are higher for dehydration in vacuum than for rehydration in nitrogen. The rates increase as the external surface increases from block through the -20 mesh to the -100 mesh material.

14137 **A chemical model of coal devolatilization using percolation lattice statistics.** Grant, D.M.; Pugmire, R.J. (Univ. of Utah, Salt Lake City, UT (US)); Fletcher, T.H.; Kerstein, A.R. (Sandia National Labs., Livermore, CA (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 322-332(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The authors have developed a model for coal devolatilization that incorporates the diversity of coal structure in such a way that the analytical data obtained from solid state NMR provides the initial input data. Using an experimentally determined kinetic rate parameters, it is possible to fit the gas, tar and char production of a lignite and high volatile bituminous coal. The authors have employed percolation theory to provide analytical expressions for the lattice statistics required in devolatilization modeling. The percolation theory allows one to avoid the more time consuming Monte Carlo technique with no loss of generality or important statistical features. Percolation theory analytically describes the size distribution of finite clusters of sites joined by intact bridges but isolated from all remaining sites by broken bridges. The theory specifies a critical bridge population, depending only on the site coordination number, above which infinite arrays will coexist with clusters of finite size. The details of the model are discussed together with the results obtained in modeling devolatilization behavior of coals of various ranks.

14138 **Coal preparation and the clean coal technology program.** Siegel, J.S. (Office of Fossil Energy, US Dept. of Energy (US));. pp v of Proceedings of coal prep 88. Aurora, CO; Industrial Presentations West (1988). (CONF-8803144—).

From Coal Prep '88; Lexington, KY, USA (22 Mar 1988).

The author discusses the subject of "Coal Preparation" and its relationship to the DOE Clean Coal Technology Program. The author describes significance of pursuing clean coal technology. In order to look in a practical way to the future of clean coal technology, the author must acknowledge and understand some of the past. The U.S. Government has been involved in coal research for many years. The Pittsburgh Experimental Station opened at Bruceton, Pennsylvania, in 1910 as an experimental mine and coal analysis laboratory for the newly formed U.S. Bureau of Mines. After more than seventy years, the much larger facility is now the Pittsburgh Energy Technology Center (PETC), with one of the leading coal preparation laboratories in the world. PETC and the Morgantown Energy Technology Center (METC) in West Virginia are both deeply involved in research and management of contract research promoting the production of clean energy from coal. DOE supports a Coal Preparation Program which includes a number of contracted research projects as well as the research conducted "in-house" by the PETC Coal Preparation Laboratory. The flexibility of coal preparation technology makes research in this area a key part of our strategy. That strategy is to make coal the continuing fuel of choice in its existing markets and to make possible the substitution of coal for petroleum and natural gas, as domestic supplies of the latter decrease in the U.S. The depth of cleaning can be controlled to optimize various end use systems. For example, the authors' studies show that advanced physical cleaning technology is part of the least cost solution for utilities to meet emission requirements when using moderate to high sulfur coals. Various cleaning techniques can be modified for use with a wide range of coals, and more severe, deep cleaning, technology is being developed to remove nearly all of the mineral matter and sulfur.

0104 Processing

REFER ALSO TO CITATION(S) 14124, 14125, 14135, 14137, 14200, 14205, 14210, 14211, 14212, 14214, 14215, 14216, 14217, 14218, 14221, 14222, 14224, 14234, 14235, 14274, 14276, 14473, 14484, 14484, 15076

14139 **(ARC/CR—8301) ENR/ARC Coal Conversion Research Program progress report for 1982-83. Plans and budget estimate for 1983-84.** du Plessis, M.P. (Alberta Research Council, Edmonton (Canada). Coal Research Dept.). 1983. Vp. (CE—02144). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report documents progress in a Canadian program largely involved in the investigation of coal liquefaction and pyrolysis. Objectives of the program are to continue a systematic investigation of coal and process types, characterize Alberta coals, examine innovative process concepts which could impact on process efficiency and economics for Alberta coals, and emphasize basic research which could have long-term impact on conversion economics, which would keep the program in the forefront of such research, and which is essential for effective interaction with other research centers. Under the liquefaction part of the program, specific projects include batch autoclave testing to evaluate coals over a range of process conditions, a hot charge/discharge project which will enable investigation of two-stage liquefaction processes, and a bench unit project in which a specially designed unit will be used to evaluate and optimize product yields and quality for coals and process conditions selected from the aforementioned projects. In the pyrolysis part of the program, Alberta's major coal regions are being evaluated under representative conditions of known flash and hydropyrolysis process. In both parts of the program, information is given on support programs such as petrographic analysis and coal chemistry. Other parts of the program reviewed in this report are the coal gasification program and the Coal Technology Information Centre. 40 refs., 2 tabs.

14140 **(ARC/CR—YCLQ-25) Final report on autoclave and bench unit tests conducted in Japan.** (Alberta Research Council, Edmonton (Canada). Coal Research Dept.). 1983. Vp. (CE—02151). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In a cooperative Japan-Canada research program, samples of coal were sent to Japanese researchers for liquefaction tests. Ten samples were studied in autoclave tests run under four different process conditions. Product characteristics and yield were examined along with the relationship between the characteristics of coal and its reactivity in liquefaction. From the results it was concluded that coals containing a large amount of volatile matter and reactive macerals were inclined to produce a larger oil yield. Two bituminous coals were found to be unsuitable as feedstocks for liquefaction. There was little difference between the liquefaction characteristics of the same coal under different reaction conditions. An apparent difference in liquefaction results between coals from different sampling sites in the same mine. Two of the coals, which showed good results in the autoclave tests, were tested in continuous liquefaction unit. In this unit, coal paste was combined with anthracene oil and catalyst and fed through the reaction vessel. Both coals showed a high conversion rate and oil yield, as in the autoclave tests. A heavy fraction was produced at low reaction temperature; but at higher temperature, formation of gas and light oil increases drastically, and the slurry in the reactor is easily coked. This indicates that optimization of reaction and operating conditions in the continuous flow unit needs further research. 19 figs., 16 tabs.

14141 (BMFT-FB-T—86-075) Definition of design criteria for, and design of, a demonstration SNG plant incorporating the commercial-size Ruhr 100 gasifier, accounting for process engineering design and economic requirements. Final report. Peyrer, H.P.; Schaefer, W.; Eichelsbacher, M. (Arbeitsgemeinschaft Projektierung SNG-Anlage, Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1986. 120p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756620/JAW.

A commercial-size plant for SNG production in a Lurgi fixed-bed gas generator is to be constructed. The study comprises constructional and process studies for determining the optimum size of a RUHR 100 type commercial gas generator as well as the optimum operating conditions. The optimum pressure range is determined by a cost analysis which takes account of both investment costs and operating costs. Cost analyses of this type were carried out for two pressure stages (30 and 90 bar). Based on the concept established in the study, a RUHR 100 prototype plant with 1+1 gas generators and a pressure of 90 bar was constructed, and cost calculations were carried out. (MOS) With 4 tabs., 19 figs.

14142 (DOE/FE—0115-2) Atmospheric Fluidized-Bed Combustion Program: Fiscal year 1989 summary program plan. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006813/JAW.

Released by the Office of Coal Technology, this report is the fiscal year 1989 summary program plan for the Atmospheric Fluidized-Bed Combustion Program. Topics covered are program management, program strategy, market applications, current technology status, technology description, background and program goals. (JL)

14143 (DOE/FE—0115-4) Surface coal gasification program: Fiscal year 1989 summary program plan. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006811/JAW.

Program plans of the Office of Coal Technology in coal gasification are briefly described. Included is a technology description, status, market applications, and program strategy and management. CBS

14144 (DOE/FE—0115-7) Alternative Fuels Program: Fiscal year 1989, Summary program plan. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 35p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006694/JAW.

Program plans of the Office of Coal Technology in the Alternative Fuels Program are presented. A technology description, status, market applications, program strategy and management are described. 1 fig., 2 tabs. (CBS)

14145 (DOE/FE—0115-11) Coal Liquefaction Program: Fiscal year 1989, Summary program plan. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006690/JAW.

Program plans of the Office of Coal Technology in coal liquefaction are presented. Technology description, status, market applications, program strategy and program management descriptions are included. 2 figs. (CBS)

14146 (DOE/FE/60877—T2) 2.1.5 Cost estimate pilot phase of COPELMI Triunfo UCG Project, Rio Grande Do Sul, Brazil. (Eastman Christensen Lateral Drilling, Houston, TX (USA)). 25 Aug 1987. Contract FC01-86FE60877. 76p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006484/JAW.

This report presents a definitive cost estimate for Eastman Christensen's lateral drilling of the pilot module for the Triunfo Coal Gasification Project. Topics covered in the report are: Lateral Drilling Technique, Project Scope, Cost Estimation Assumption, Rig and Surface Equipment, Drilling Prognosis, Bill of Materials, Unit Price Summary, and Job Cost Summary. (JF)

14147 (DOE/MC/11076—2639) Results of the groundwater restoration project, Hanna Underground Coal Gasification Test Site, Wyoming: Topical report. Oliver, R.L. (Western Research Inst., Laramie, WY (USA)). Jan 1988. Contract FC21-86MC11076. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000915/JAW.

Underground coal gasification (UCG) experiments conducted during the 1970s at the Department of Energy (DOE) site near Hanna, Wyoming, formed six underground cavities in the Hanna No. 1 coal seam, an aquifer of low permeability. When the first Hanna UCG experiment began in March 1973, researchers had little information about what effects the geologic or hydrologic characteristics of the area might have on the UCG process; likewise, the effects of UCG on the environment were unknown. Since the UCG experiments were completed, dilute concentrations of pyrolysis products and leachates have been detected in groundwater monitoring wells in and near some of the six cavities. Three primary UCG indicator constituents have been measured at elevated concentrations: phenols, TDS, and sulfate. The Hanna III cavity water exceeded the DOE target level for TDS and sulfate, and the Hanna I cavity water exceeded the DOE target level for phenols. The indicated phenols contamination, however, was in groundwater sampled from a well which was previously used as a production well during the experiment. Water pumped during the restoration project and a new well located approximately 10 ft from the old production well was sampled and no elevated phenols concentration was detected. Therefore, the restoration performed on the Hanna I cavity water was not necessary. The restoration was performed, however, because these indications were not available until during the restoration. Locally, various other constituents exceed DOE target levels, but concentrations are very near target levels and are well within livestock use limits. 2 refs., 7 figs., 5 tabs.

14148 (DOE/MC/22050—2630) Chemical and physical development of char particles during devolatilization: Final report. Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Markham, J.R.; Best, P.E.; Bassilakis, R. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). May 1988. Contract AC21-85MC22050. 127p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE88010290/JAW.

The objective of this project was to explore the chemical and physical development of coal char particles during devolatilization and, from the data obtained, develop predictive models which would describe the chemical and physical properties of the chars as they develop and change in the devolatilization process. These predictive models relate the chemical, thermal, optical, other physical properties, and kinetic rates to time, temperature and composition parameters as they change in the devolatilization process. Experiments were performed to study the chemical and physical transformation of char during devolatilization. These experiments were used to determine the controlling mechanisms for the transformation and to develop computer models to describe it. Experiments were performed in several existing facilities (an entrained flow reactor, a heated tube reactor, and a Thermogravimetric analyzer) with analysis of evolved products by Fourier Transform Infrared spectroscopy (TG-FTIR), which were previously described. A new non-isothermal technique was developed for measuring char reactivity and a new transparent wall reactor was built to study devolatilization and combustion using in-situ FT-IR diagnostics. Results were obtained for the spectral emittance of coal and its transformation during devolatilization. The question of heat transport between coal particles and their environment was studied. Measurements were made for char reactivity and its relationship with coal properties and pyrolysis conditions. A new general model of coal devolatilization was developed. An equilibrium model was added to the general model to describe the high temperature gas phase reactions and an evaluation was made of kinetic rates measured at AFR and reported in the literature to identify reasons for the discrepancies and identify the most reliable values. 113 refs., 75 figs., 16 tabs.

14149 **(DOE/MC/23075—2629) Measurement and modeling of advanced coal conversion processes: Quarterly report, April--June 1988.** Solomon, P.R.; Hamblen, D.G.; Serio, M.A.; Smoot, L.D.; Brewster, S. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Jun 1988. Contract AC21-86MC23075. 141p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE88010289/JAW.

The overall objective of this program is the development of predictive capability for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. The foundation to describe coal-specific conversion behavior will be AFR's Functional Group (FG) and Devolatilization, Vaporization, and Crosslinking (DVC) models, developed under previous and ongoing METC sponsored programs. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The FG/DVC models will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (1) validation of the submodels by comparison with laboratory data obtained in this program, (2) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigations of gasification, mild gasification and combustion of coal or coal-derived products in heat engines, and (3) development of well documented user-friendly software applicable to a "workstation" environment. Progress is described. 85 refs., 33 figs., 3 tabs.

14150 **(DOE/MC/23075—2648) Measurement and modeling of advanced coal conversion processes: Second annual report, October 1987--September 1988.** Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Smoot, L.D.; Brewster, S. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Oct 1988. Contract AC21-86MC23075. 248p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000921/JAW.

The overall objective of this program is the development of predictive capability for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. This technology is important to reduce the technical and economic risks inherent in utilizing coal, a feedstock whose variable and often unexpected behavior presents a significant challenge. This program will merge significant advances made at Advanced Fuel Research, Inc. (AFR) in measuring and quantitatively describing the mechanisms in coal conversion behavior, with technology being developed at Brigham Young University (BYU) in comprehensive computer codes for mechanistic modeling of entrained-bed gasification. Additional capabilities in predicting pollutant formation will be implemented and the technology will be expanded to fixed-bed reactors. The foundation to describe coal-specific conversion behavior will be AFR's Functional Group (FG) and Devolatilization, Vaporization, and Crosslinking (DVC) models, developed under previous and on-going METC sponsored programs. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The FG-DVC model will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (1) validation of the submodels by comparison with laboratory data obtained in this program, (2) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigation, mild gasification and combustion of coal or coal-derived products in heat engines, and (3) development of well documented user friendly software applicable to a "workstation" environment.

14151 **(DOE/MC/24206—2631) Technical and economic evaluation of a gasifier energy storage system clean carbon production: Final report.** Skinner, F.D.; Raden, D.P. (Radian Corp., Austin, TX (USA)). Aug 1988. Contract AC21-87MC24206. 69p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE88010291/JAW.

The ultimate objective of this project is the development of an integrated system for producing clean carbon-based products from coal that is based on low-cost existing gasification technologies; can utilize all coal types as feedstocks; does not require exotic materials of construction; produces a product with high market values; and has significant cost advantages over potential competing processes. This report presents the results of the first phase of this project, whose objective is to determine whether the concept is technically feasible and economically attractive. This assessment involves the following work activities: conducting a review of the publicly available literature related to the catalytic production of carbon from carbon monoxide; developing conceptual designs for potential process systems; performing heat and material balances for the most attractive process concepts; sizing equipment; and estimating capital and operating costs in order to determine the possible product cost.

14152 **(DOE/PC/70042—T7) Research of coal liquefaction co-processing: Final technical report for period October 1984--February 1988.** (Lummus Crest, Inc., Bloomfield, NJ (USA)). Sep 1988. Contract AC22-84PC70042. 261p. NTIS, PC A13/MF A01 - OSTI; 1; GPO Dep. Order Number DE88016559/JAW.

A three-year, multi-task experimental program was carried out under joint funding by DOE and Lummus Crest Inc., to investigate the co-processing of coal and petroleum liquids based on the LC1 co-processing concept. The latter consists of a two-stage (thermal-catalytic) integrated process in which feed coal is slurried with a hydrogenated petroleum resid and liquefied in a short contact time (SCT) thermal stage. The resultant SCT products are then fed in a close-coupled manner to a catalytic, expanded-bed hydrocracker (LC-Finer/sup sm/). A portion of the resultant co-processed LC-Finate vac bottoms is recycled to supplement the hydrogenated petroleum resid-based solvent as necessary depending upon coal type and petroleum resid source. The experimental program consisted of batch microautoclave tests (MAT); continuous once-through (no solvent recycle) stirred autoclave tests and extended catalyst activity maintenance tests in an integrated two-stage (SCT and LC-Fining/sup sm/) bench-scale unit. The data from the experimental testing was used as the basis for generating a conceptual design of a commercial-scale co-processing facility. 6 refs., 44 figs., 97 tabs.

14153 **(DOE/PC/79908—T4) The hindered diffusion of coal liquids under non-reactive and high temperature and pressure reactive conditions: Quarterly report No. 4, June 15, 1988--September 14, 1988.** Tsotsis, T.T.; Sahimi, M.; Webster, I.A. (University of Southern California, Los Angeles (USA). Dept. of Chemical Engineering). 1988. Contract FG22-87PC79908. 47p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005812/JAW.

We have undertaken a theoretical and experimental study of "hindered diffusion" of model and real petroleum and coal liquids in model and real coal liquefaction and hydroprocessing catalysts under reactive and non-reactive conditions. Specifically we intend to carry out the following tasks: (1) To theoretically study the mechanism of configurational diffusion and reaction of liquid macromolecules in porous catalysts, and attempt to relate and substantiate such studies with high quality, reproducible experimental data. (2) To measure configurational diffusivities of model oil compounds such as metal porphyrins through model and real porous systems. The model porous systems are polycarbonate, mica and anodized alumina membranes, all characterized by straight, basically unimodal cylindrical pores. (3) To measure the diffusivity of petroleum- and coal-liquid derived asphaltenes under nonreactive and reactive conditions in model and real alumina membranes. 54 refs., 6 figs.

14154 **(DOE/PC/79912—5) Thiophene metabolism by E. coli: Technical progress report, September 15--December 15, 1988.** Clark, D.P. (Southern Illinois Univ., Carbondale (USA). Dept. of Microbiology). [1989]. Contract FG22-87PC79912. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006468/JAW.

The objective of this project is to investigate the mechanism of thiophene and furan degradation by mutants of Escherichia coli K-12 which have gained the ability to use such heterocyclic compounds. We hope to characterize the genes involved in these novel

breakdown pathways and, if possible to assay the activities of the corresponding activities. Previous work resulted in the isolation of a series of mutants of E. coli with increasing ability to oxidize furan and thiophene derivatives. Mutations in three novel genes were involved, thdA, thdC and thdD together with mutations in fadR ("thdB") and atoC. Of these thdA gave the biggest observable effect and we have therefore focused on this gene in our more recent work. Although the nature of the thdA system is still unknown, it is clearly rather non-specific (as is P450) and can be mutated to various mutant forms with different specificities. Lastly, we isolated novel furan degrading mutant starting from a different genetic background. These mutants contrast with those made from DC625 in that they could use furans and benzoic acid as sole carbon and energy source implying complete degradation. The new mutants showed moderate activity against some thiophene derivatives but not others. These mutants are very interesting and will be further analysed both genetically and for their biochemical properties.

14155 **(DOE/PC/79926—4) Kinetics of coal conversion to soluble products: Quarterly report, July 1, 1988--September 30, 1988.** Yamada, O.; Larsen, J.W. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 25 Jan 1989. Contract FG22-87PC79926. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006097/JAW.

Under investigation is a new experimental method for measuring the kinetics of coal conversion to soluble materials and the analysis of the new kinetic data by methods not yet applied to coal conversion. We have constructed and thoroughly tested a gel permeation chromatograph with a mass sensitive detector. This chromatograph has been calibrated with coal extract fractions whose molecular weights have been individually measured by vapor pressure osmometry. We are using this instrument to monitor the kinetics of coal conversion by measuring the molecular weight distribution of the soluble products as a function of time. 9 refs., 3 figs.

14156 **(DOE/PC/80002—9) Low-severity catalytic two-stage liquefaction process: Final summary report, 1 September 1985--February 1988.** Comolli, A.G.; Duddy, J.E.; Johanson, E.S.; Smith, T.O. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Sep 1988. Contract AC22-85PC80002. 159p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003441/JAW.

Hydrocarbon Research, Inc. (HRI) has been actively involved in the development of a low-severity two-stage coal liquefaction process. Since inception of the concept of low-temperature, first-stage hydrogenation followed by a higher temperature second-stage hydrocracking operation, in 1982, efforts have been concentrated on this process. This final report covers development efforts under both contracts from October 1983 to March 1988. The major objective was to reduce process severity and improve economics. Studies were conducted on Illinois No. 6 and Ohio No. 5/6 bitumen coals and included several process variable experiments, catalyst testing, use of cleaned coal and evaluation process recycle options. The total effort included 277 days onstream of continuous bench-scale operations, and data analysis and process modeling, and engineering design and economic studies are reported herein. 13 refs., 15 figs., 40 tabs.

14157 **(DOE/PC/80502—T12) Interactive chemistry of coal-petroleum processing: Quarterly report, September 16, 1988--December 15, 1988.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). 1988. Contract FG22-85PC80502. 39p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005736/JAW.

The objective was to investigate the interactive thermal and catalytic chemistry of coal and petroleum processing using model compounds and actual petroleum-coal materials. Major tasks were (1) evaluate the thermal chemistry in three different model coal-petroleum systems composed of (a) hydrocarbons, (b) hydrocarbons and heteroatoms and (c) hydrocarbons, heteroatoms and metalloporphyrins; (2) evaluate the catalytic chemistry of coal-petroleum processing using three different model systems--hydrocarbons, heteroatoms and metalloporphyrins with selected transition metal sulfide catalysts; and (3) evaluate the thermal and catalytic chemistry of actual coal-petroleum systems. 12 refs., 1 fig., 9 tabs.

14158 **(DOE/PC/80507—T12) Catalytic coal gasification: Identification of active sites: Final report, October 15, 1985--October 14, 1988.** Falconer, J.L.; Lauderback, L.L. (Colorado Univ., Boulder (USA). Dept. of Chemistry). 19 Jan 1989. Contract FG22-85PC80507. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005761/JAW.

This research uses transient isotope tracing, at steady-state reaction conditions, in combination with surface analysis techniques (secondary ion mass spectrometry (SIMS) and x-ray photoelectron spectroscopy (XPS)). Carbon dioxide gasification of carbon blacks and coal char will be used initially, since this appears to be rate-determining during steam gasification; steam gasification will be used in later experiments. In a typical isotope tracing experiment, $^{12}CO_2$ flow over a carbon-catalyst mixture will be quickly replaced by $^{13}CO_2$ at the same pressure and flow rate. The changes in the concentrations of ^{12}CO and ^{13}CO products, and in the $^{12}CO_2$ and $^{13}CO_2$ concentrations, as a function of time, will be measured with a computer-controlled mass spectrometer. The use of isotope transients allows the concentration of active catalytic sites to be measured directly at reaction conditions and it allows the rate constant to be measured. Isotope tracing will be carried out as a function of reaction temperature, catalyst loading, catalyst type and carbon conversion. Surface analysis techniques will be used to determine the active forms of the catalysts. Model studies of catalyst-carbon interactions will also be carried out with SIMS in order to determine the form of surface species. The combination of isotope tracing and surface analysis will elucidate the details of the reaction mechanism. This insight into the mechanism of coal gasification will help in improving process kinetics for gasification.

14159 **(DOE/PC/80908—10) Low severity coal conversion by ionic hydrogenation: Quarterly report, October--December 1988.** Maioriello, J.; Larsen, J.W. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 31 Dec 1988. Contract FG22-85PC80908. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006463/JAW.

A newly developed reaction system consisting of H_2O:BF_3/H_2/$(CH_3CN)_2PtCl_2$ was applied to the ionic hydrogenation of aromatic and functionalized aromatic compounds. Hydrogenations were carried out in this aqueous system at 50{degree}C and 500 psi H_2. Aryl ethers were hydrogenated and cleaved, yielding deoxygenated, fully saturated compounds as the major products. Reactions of nitrogen-containing aromatic compounds resulted in partial saturation of aromatic rings without cleavage of the C-N bonds. Aromatic and PNA compounds can be fully or partially hydrogenated depending on their structures. Aromatic thiols, sulfides and thiophenes poison the catalyst; the oxidized sulfur forms (sulfonic acids, sulfones) were not reduced and did not poison the catalyst. It was found that certain aromatic compounds were easier to hydrogenate than others. Ionic hydrogenation of Wyodak cola using a H_2O:BF_3/H_2/$(MeCN)_2PtCl_2$ resulted in no significant increase in THF extractability (5.8--9.6% THF-extractables, wt) over that of the parent coal (4.6--6.7% THF-extractables, wt). Ionic hydrogenation of a demineralized Wyodak coal (1 M aq. citric acid, reflux 1 day) resulted in a slight increase in THF extractability (10.4%) over the untreated parent coal (5.6--5.8%). 4 refs., 1 fig., 1 tab.

14160 **(DOE/PC/88942—1) Novel supports for coal liquefaction catalysts: Quarterly report No. 1, 1 September 1988--30 November 1988.** Haynes, H.W. Jr.; Papaioannou, A. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 21 Dec 1988. Contract FG22-88PC88942. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006756/JAW.

A commercial CoMo/Alumina catalyst (Amocat 1A) was promoted with alkali (Li, Na, K) and alkaline earth (Be, Mg, Ca and Ba) metals at varying levels and subjected to acid sites characterization by the temperature programmed desorption of t-butylamine. The acid sites could be completely extinguished with the alkali metals and with ca and Ba. Only a small reduction in acidity could be achieved with Mg and Be. The original catalyst and the Mg- and Ca- promoted catalysts were each subjected to 250 hour deactivation runs in a laboratory trickle bed hydrotreater using a coal derived liquid containing 20% residuum material. All three

catalysts exhibited comparable hydrogenation activities, but the activities for hydrodenitrogenation decreased in the order: unpromoted > Mg-promoted > Ca-promoted. Coke deposition on the used catalysts was in the order: unpromoted (17.2 wt %) > Mg-promoted (13.2 wt %) > Ca-promoted (9.8 wt %). Acidity decreases in the same order. Promotion with alkali and alkaline earth metals appears promising as a means of preparing active catalysts having a reduced coking tendency for coal hydrogenation applications. 17 refs., 6 figs., 4 tabs.

14161 **(DOE/PC/90523—15) Phase behavior of coal fluids: Data for correlation development: [Progress] report, August 15, 1988--December 31, 1988.** Robinson, R.L. Jr. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 15 Dec 1988. Contract FG22-86PC90523. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006095/JAW.

During the present report period, a framework was developed for correlating saturation properties using a scaled-variable-reduced-coordinate approach. The framework is demonstrated by correlating the vapor pressures of a number of compounds over the temperature range from the triple point to the critical point. A new correlation based on the proposed method results in precise representation of the vapor pressures of diverse chemical species with average errors of about 0.1% (essentially within the experimental uncertainties). Although the approach is basically empirical, the results obtained suggest an underlying physical significance for the model parameters and an excellent potential for generalized predictions. 38 refs., 7 figs., 4 tabs.

14162 **(DOE/PC/90533—8) Deactivation by carbon of iron catalysts for indirect liquefaction: Annual technical progress report, September 15, 1987--September 14, 1988.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 25 Jan 1989. Contract FG22-86PC90533. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006466/JAW.

During the second year construction of a computer-automated reactor system to be used in the kinetic and deactivation studies was completed. The control language, control routines, and software for operating this system were essentially completed. Progress was also made on the operating manual and testing of the system. CO hydrogenation activity/selectivity tests were conducted on unsupported iron catalysts reduced at 300 or 400{degree}C. Deactivation leading to loss of surface area was experienced after rereduction at 400{degree}C. 47 refs., 5 figs., 4 tabs.

14163 **(EPRI-GS—6173) Development of an IGCC power plant simulator: Final report.** Rovnak, J.A. (Electric Power Research Inst., Palo Alto, CA (USA); Stone and Webster Engineering Corp., Boston, MA (USA)). Feb 1989. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89007014/JAW.

This report provides the results of the Electric Power Research Institute project to develop a dynamic simulator for Integrated Coal Gasification Combined Cycle (IGCC) power plants. With the introduction of commercial chemical process-oriented technology into the utility industry, there was a need for better computer-based project design tools to be used from conceptual design through commercial operation. A major project objective was the development of unified computer programs for use in process design, control system design, operations planning, and training simulators. The importance of the rapid advance in computer hardware and support software is due to the possibility of using these programs on a small but powerful, low cost desktop computer. This design tool will: lead to more comprehensive evaluation of alternatives during plant conceptual design; speed the design process; reduce errors; help prepare operating procedures; diagnose faulty equipment; improve performance; and assist in training operators and engineers. This report describes the approach and methodology used for IGCC simulator development and provides the related sample output and results. It also includes the results of a special exercise which demonstrated the unique approach in which an engineering analysis computer code was also used for real-time training simulation on a minicomputer. 12 refs., 26 figs., 11 tabs.

14164 **(EPRI-GS—6176) Florida Power and Light Company's study of shell-based GCC power plants: Final report.** Hevia, R.A.; Smith, W.H.; Walters, A.B. (Electric Power Research Inst., Palo Alto, CA (USA); Florida Power and Light Co., Miami (USA)). Jan 1989. 339p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89007020/JAW.

This report presents the results of a utility and site-specific study conducted by the Florida Power and Light Company (FPL) with the support of EPRI to evaluate the performance and cost of phased, Shell-based, coal gasification combined-cycle power plants. The active participants during the course of this study were FPL, Fluor Daniel, Inc., the Shell Oil Company, the General Electric Company and EPRI. Two phased construction cases each with a final phase nominal power output of 400 MW were evaluated. In each case, the first phase consists of GE MS7001F combustion turbines operating in simple-cycle mode. In Phase 2, the combined cycle power plant is added to the combustion turbines increasing the net power produced. Finally, in the third phase, a gasification plant is constructed to supply enough fuel gas to fully load the combustion turbines at a 95{degree}F ambient temperature. The first case consists of a fully integrated GCC plant taking advantage of preinvestment in the second phase to accommodate the additional steam production in Phase 3. Case 2 examines a nonintegrated plant where the combined cycle facility is located 97 miles from the gasification plant and the medium Btu gas is transported to the combined cycle plant via a pipeline. In this case there is no preinvestment in Phase 2. Economy of Scale effects were also evaluated, based on the integrated 400 MW plant, to determine the potential savings in building larger IGCC plants in the 800 and 1600 MW range. This data was used by FPL, for comparison purposes, to develop several different long-range capacity addition scenarios and to determine the potential net savings between said plans and a pulverized coal power plant expansion plan. 61 figs., 125 tabs.

14165 **(FRNC-TH—3393) Theoretical and experimental study of a solar gasifier for carbonaceous materials in a porous moving bed.** Belghit, A. (Perpignan Univ., 66 (France)). 1986. 184p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756632/JAW.

This work analyzes performance of a solar chemical reactor for coal gasification. Influence of different parameters: temperature, grain size, flow rate on chemical reaction and thermal efficiency is examined. A thermogravimetric analysis shows that above 1000/sup 0/C the process is limited by external diffusion, belov 900/sup 0/C gasification rate is determined by chemical reaction kinetics and between 900 and 1000/sup 0/C there is a mixture of both. A model is proposed and validated.

14166 **(ORNL/Sub—85-43397/02) Alkali attack of coal gasifier refractor linings.** Brown, J.J. Jr. (Oak Ridge National Lab., TN (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Materials Engineering). 15 Dec 1988. Contract AC05-84OR21400. 106p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005673/JAW.

This investigation examines the alkali-refractory corrosion in non-slagging coal gasifiers and in the non-slagging portions of slagging gasifiers. The alkali species in a typical gasifier atmosphere were calculated using the SOLGASMIX-PV computer program. Reactions between alkali and refractory castables, fireclay refractories, and alumina-chromia brick were first computed theoretically and then selectively confirmed experimentally. Alkali-alumino silicate compounds were synthesized and their thermal expansion properties and water solubilities were measured. Below 20 atm pressure, alkali is present in gasifiers as solid or liquid oxides, hydroxides, carbonates, or sulfides up to about 1400K; above this temperature most of the compounds exist as vapor species, including alkali metal vapor. At 1400K and above, the specific alkali phases are quite pressure sensitive. Alkali corrosion of calcium aluminate castables refractories is primarily confined to the cement phase. The results of alkali corrosion of alumina-chromia refractories, both experimental and theoretical, show formation of alkali-aluminate (Na_2Ocenter←dotAl_2O_3, K_2Ocenter←dotAl_2O_3) and β-alumina (Na_2Ocenter←dot$11Al_2O_3$, K_2Ocenter←dot$11Al_2O_3$) com-

pounds with formation of several metastable alkali compounds. Sulfur did not appear to affect the reaction products. 50 refs., 32 figs., 26 tabs.

14167 **Evaluation of the interactive chemistry of coal-petroleum systems using model and actual reactants.** Curtis, C.W.; Chung, W.J. (Chemical Engineering Dept., Auburn Univ., AL (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 65-70(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The coprocessing of coal with petroleum residuum simultaneously liquefies coal and upgrades petroleum residuum into higher value products. However, coal and petroleum residuum manifest very different chemical properties with coal being more aromatic with a H/C ratio of 0.6 - 0.8 and petroleum residuum more aliphatic with a H/C ratio of 1.4 to 1.6. Although a number of studies have demonstrated the feasibility of coprocessing on the basis of product selectivity and metals reduction (1-8), the interactive chemistry involved between the coal and petroleum materials during coprocessing has not yet been determined. In this study, the interactive chemistry between coal and petroleum molecules have been examined: first by using model compound types representative of coal and residuum and then by combining the model systems will Illinois No. 6 coal and Maya topped long residuum (TLR). The model systems, composed of napthalene (NAPH) representing aromatics, 1,4- dimethylcyclohexane (DMC) representing saturated compounds, phenol (PN) representing phenolics, benzothiophene (BZT) representing suflur compounds, and quinoline (QN) representing nitrogen compounds, were reacted thermally and catalytically using a Shell 324 NiMo/Al/sub 2/O/sub 3/ catalyst. The model systems were reacted individually and then combined together to ascertain the effect of the different components on the thermal and catalytic reactions of the different model systems. Illinois No. 6 coal and Maya TLR were each, respectively, added to the model compound systems and reacted thermally and catalytically.

14168 **Removal of H/sub 2/S from coal-derived gases.** Lynn, S.; Hix, R.M.; Neumann, D.W.; Sciamanna, S.F.; Stevens, C.A. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 300-305(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

When coal is gasified most of the sulfur is converted to H/sub 2/S and must be removed before the gas can be used either as a fuel or as synthesis gas. The UCB Sulfur Recovery Process (UCBSRP) is being developed as a general method for removing H/sub 2/S from gases. The H/sub 2/S is absorbed in a polyglycol ether, then reacted in the liquid phase with SO/sub 2/ to form marketable elemental sulfur and water. The process allows high specificity and flexibility; H/sub 2/S can be reduced to the part-per-million level or below in the presence of CO/sub 2/ and the other components of gasified coal. The CO/sub 2/ may be left in the original gas stream or it may be co-absorbed and recovered as a separate, sulfur-free product. The process thus has application both to syngas and hydrogen production from O/sub 2/-bloown gasifiers and to power production using an air-blown gasifier.

14169 **The removal of impurities from hot coal-derived gas by filtration.** Grindley, T.; Logan, R.G. (U.S. Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 315-328(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

At the Morgantown Energy Technology Center (METC) of the U.S. Department of Energy, an effort is underway to clean hot coal-derived gas to a sufficient purity for combustion in heat engines and other applications. Experiments were conducted in which the hot product gs, raw and desulfurized, from a fluid-bed coal gasifier was filtered at temperatures up to 1,600°F, pressures up to 250 psig, and flow rates up to 2,500 scfh. Particulate and condensate samples were collected at the inlet and outlet of the filters and analyzed for 10 metals which are common constituents of coal ash. The results were used to determine how filtration of particles from a gas stream at high temperatures affected metal concentrations in the gas. In general, the removal efficiency for the metals correlated with the particulate removal efficiency.

14170 **The chemical origin of synergy in liquefaction and coprocessing.** McMillen, D.F.; Malhotra, R.; Tse, D.S.; Nigerida, S.E. (Dept. of Chemical Kinetics, Chemical Physics Lab., SRI International, Menlo Park, CA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 58-64(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The question of possible synergistic effects for coal liquefaction has been raised recently in the context of coprocessing and also in that of straight donor-solvent liquefaction. Synergy is generally defined to occur when the effect of a combination of components exceeds the sum of the effects of the individual components. The existence of such synergism is more difficult to demonstrate in the coprocessing context, because liquefaction of coal alone, that is, in the presence of any other component (e.g., residual oil), is not viable in process terms, and therefore one of the boundary conditions is not available. Synergism can be much more readily assessed in the context of straight liquefaction, where there is always a liquefaction medium, which can be made up of a number of components. This paper specifically addresses liquefaction data, but the conclusions drawn are all equally applicable to coprocessing. Recently there have been several reports of coal liquefaction illustrating the interactive effect of various components. The authors have used these results in conjunction with an improved mechanistic model for coal liquefaction to help shed some light on the chemical origin of such interactive effects. Specifically, the authors show that the various H-transfer processes that they have hypothesized as leading to bond cleavage by "solvent-mediated hydrogenolysis" clearly fall in the second category of reaction type.

14171 **Coal/oil coprocessing mechanism studies.** Cugini, A.V.; Lett, R.G. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA (US)); Wender, I. (Univ. of Pittsburgh, Dept. of Chemical and Petroleum Engineering, Pittsburgh, PA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 71-88(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Initial coprocessing studies, performed to provide a basis for larger scale tests of coprocessing options using batch one-liter autoclave and continuous hydrotreater facilities at PETC, are described. Areas investigated included the response of coal and petroleum resid combinations to processing under thermal hydrotreatment conditions, the means of increasing the conversion of coal, and the nature of resid demetalation effects. The petroleum resids processed rather low donable-hydrogen capacities, and the interactions between the resids and coals are weak with respect to promoting formation of liquid products under thermal conditions. Maya ATB was superior to Boscan ATB or North Slope VTB for the conversion of Illinois No. 6 coal to liquid or soluble products. The Maya ATB/Illinois No. 6 coal system responded favorably to the addition of low concentrations of a highly dispersed, unsupported molybdenum catalyst. Extensive demetalation of the liquid product was observed and was a function of the amount of coal added. Results obtained using different coal and resid combinations, under thermal and catalytic conditions, and in the presence of various additives, imply that an absorptive mechanism is operative. The primary interactions leading to demetalation appear to be between the metal complexes of the resid and the insoluble carbonaceous coal-derived material. Demetalation of the liquid product was not observed to be dependent on conversion of the organically complexed metal in the resids to inorganic form.

14172 **Performance of hydrous titanium oxide-supported catalysts in coal-liquids upgrading.** Cillo, D.L.; Smith, D.N.; Ruether, J.A. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA (US)); Stephens, H.P.; Dosch, R.G. (Sandia National Labs., Albuquerque, NM (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 348-354(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Experimental tests were performed in a continuous-flow hydrotreating unit at Pittsburgh Energy Technology Center to evaluate the performance of hydrous titanium oxide-supported (HTO) catalysts as hydrotreating catalysts for use in two-stage coal liquefaction. Catalysts containing either a combination of Co, Ni, and MO as the active metal components or Pd as the active metal component were tested with representative hydrotreater feed stocks from the Wilsonville Advanced Coal Liquefaction Resarch and Development Facility. Catalyst performance evaluation was based on desulfurization and denitrogenation activity, the conversion of cyclohexane-insoluble material, and hydrogenation activity during 100-hour reactor runs. Results indicated that the HTO catalysts were comparable to a commercial Ni/Mo-alumina supported catalyst in the areas evaluated.

14173 **Process options for extinction recycle conversion of heavy oils in catalytic two stage liquefaction.** Comolli, A.G.; Johanson, E.S.; McLean, J.B.; Smith, T.O. (Hydrocarbon Research, Inc. (A subsidiary of DynCorp), P.O. Box 6047, Lawrenceville, NJ (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 364-375(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Hydrocarbon Research, Inc. (HRI) is developing a Catalytic Two-Stage Liquefaction (CTSL) Process which converts coal to distillate liquid products. A particularly attractive feature of the process that has been demonstrated recently using two bituminous coal feedstocks (Illinois No. 6 and Ohio No. 5/6 coals) is the capability to achieve extinction conversion of heavy oil products (heavy vacuum distillate and soluble residuum oil) through integration of coal cleaning, product solids separation, and selective recycle. Yields of distillate oils of up to five barrels per M.A.F. ton of coal have been achieved. Elimination of heavy oils and boiling points above 700 - 750°F greatly simplifies downstream processing requirements. Several process configuration options and the resulting yield distributions are discussed.

14174 **Activity and selectivity of molybdenum catalysts in coal liquefaction reactions.** Curtis, C.W.; Pellegrino, J.L. (Chemical Engineering Dept., Auburn Univ., AL (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 376-383(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

During coal liquefaction, coal fragments forming a liquid product with reduced heteroatom content. Coal can be considered to be a large network of polynuclear aromatic species connected by heteroatoms and alkyl bridging structures. Predominant heteroatoms contained in coal are sulfur, oxygen, and nitrogen. Predominant alkyl bridges are methylene and ethylene structures. The purpose of this work is to evaluate how effectively three different molybdenum catalysts promote reactions involving heteroatom removal and cleavage of alkyl bridge structures. The reactions studied include: hydrogenation (HYD), hydrodeoxygenation (HDO), hydrosulfurization (HDS), hydrodenitrogenation (HDN) and hydrocracking (HYC). Both model and coal liquefaction reactions were performed to test the activity and selectivity of three different molybdenum catalysts. The three catalysts used were molybdenum napththenate, molybdenum supported on gamma alumina (Mo/Al/sub 2/O/sub 3/) and precipitated, poorly crystalline molybdenum disulfide (MoS/sub 2/). The model compounds, chosen to mimic coal structure, on which the effectiveness of the catalysts for the model reactions was tested were: 1-methylnaphthalene, representing aromatic hydrocarbons, for hydrogenation; 1-naphthol, representing oxygen containing compounds, for deoxygenation; benzothiophene, representing sulfur containing compounds, for desulfurization; indole, representing nitrogen containing compounds, for denitrogenation; and bibenzyl, representing alkyl bridging structures, for hydrocracking. Catalytic reactions of combinations of reactants were performed to simulate a complex coal matrix. Thermal and catalytic coal liquefaction reactions were performed using Illinois No. 6 coal with anthracene as a solvent. The efficacy of the catalysts was determined by comparing the product and compound class fractions obtained from the liquefaction reactions.

14175 **Evolution of sulfur gases during coal pyrolysis.** Oh, M.S.; Burnham, A.K.; Crawford, R.W. (Lawrence Livermore National Lab., Livermore, CA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 274-282(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The yields and rates of evolution of sulfur gases depend not only on pyrolysis conditions but also on the coal itself. The organic/inorganic forms of sulfur, as well as the secondary reactions of sulfur gases with solids and with other pyrolysis-generated gases, play an important role. Monitoring the time- and temperature-dependent evolution of sulfur-containing gases provides insight into the sulfur chemistry affecting evolution profiles. Programmed-temperature studies of sulfur gas evolution often have been limited to H/sub 2/S. In some cases, all sulfur gases have been studied collectively by reducing or oxidizing them to H/sub 2/S or SO/sub 2/. In this study, the authors monitored the real-time evolution of sulfur gases during slow-heating pyrolysis via a triple quadrupole mass spectrometer (TQMS). They also monitored the evolution of hydrocarbon gases, water, and carbon oxides. They compared the evolution profiles of sulfur gases and related them to the rank of the coal, the organic and inorganic sources of sulfur in each coal sample, and the evolution of other pyrolysis-generated gases. They also studied the extent of secondary reactions by varying the pyrolysis conditions.

14176 **Desulfurization of coal by photo-oxidation.** Mathur, V.K.; Murphy, S. (Dept. of Chemical Engineering, Univ. of New Hampshire, Durham, NH (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 232-238(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Desulfurization of coal by oxidative methods has been investigated by several workers. These techniques primarily involve selective oxidation of organic sulfur to sulfoxide and sulfones, followed by thermal decomposition of the oxidation product. In this study, photo-oxidation of sulfur in coal is investigated. Finely divided coal samples, suspended in solvent(s), are exposed to radiation using ultraviolet and xenon lamps. The coal samples are next subjected to hydrolysis to remove the oxidized sulfur from the coal matrix. The effect of wave length, light intensity, slurry concentration, and duration of exposure is studied. The maximum desulfurization achieved is about 42%.

14177 **Sorbent-based recovery of sulfur from regeneration tail gases.** Gangwal, S.K.; Harkins, S.M. (Research Triangle Institute, Research Triangle Park, NC (US)); Dorchak, T.P. (Morgantown Energy Technology Center, Morgantown, WV (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 306-309(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

This paper discusses the results of experimental theoretical research on two novel process concepts for elemental sulfur production from regeneration tail gases. Both concepts utilize a highly efficient sodium/aluminum (Na/Al) based SO/sub 2/ sorbent at elevated temperatures (800 to 1,000 K) and pressures (1 to 3 MPa). One concept involves sulfation of the Na/Al sorbent with the tail gas followed by regeneration with reducing gas to produce a suitable Claus plant feed. The sulfated Na/Al sorbent is then regenerated using a small side stream of the coal gasifier gas. The resulting concentrated sulfur stream at elevated temperature and pressure

containing from 10 to 50 percent H/sub 2/S is a suitable feed for a Claus plant for elemental sulfur recovery.

14178 Modeling of a high-temperature direct coal gasification process in a two-stream reactor. Hanjalic, K.; Sijercic, M. (Univ. of Sarajevo-Energoinvest, Sarajevo (YU)); Crowe, C.T.; Wojcicki, S. (Washington State Univ., Pullman, WA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 138-144(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A new scheme for direct gasification of pulverized coal has been analyzed by a mathematical model. Gasification occurs in the annular region of a cylindrical reactor during the cocurrent flow of a steam/coal mixture, with combustion products in the reactor core region serving as an internal heat source. The model incorporates the two equation model for turbulence, mass exchange between phases due to chemical reactions and radiative heat transfer. Detailed calculations are carried out to asses the feasibility of the scheme.

14179 Application of first-order single-reaction model for coal devolatilization over a wide range of heating rates. Ko, G.H.; Sanchez, D.M.; Peters, W.A.; Howard, J.B. (Dept. of Chemical Engineering and Energy Lab., Massachusetts Institute of Technology, Cambridge, MA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 112-119(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The first-order single-reaction model offers a simple but effective mathematical description of coal devolatilization. Under conditions where the effects of physical transport processes and secondary reactions are relatively small but not negligible, the model approximates the complex chemical decomposition and any transport effects by a single global first-order decomposition reaction occurring uniformly throughout the particle. In more complete devolatilization descriptions that explicitly include mass transfer, the model represents only the chemical decomposition. The model is most useful in applications where minimizing computational effort is important such as in large combustion or gasification models that fully describe fluid mechanics, heat and mass transport, and reaction kinetics; and in comprehensive devolatilization models that explicitly include the complex decomposition and secondary reaction chemistry, and multicomponent mass transfer in a gaseous or liquid phase environment. However, the model has a major weakness in that a different set of rate parameters is required at different heating rates. Thus, for a given set of rate parameters, the applicability of the model is confined to a narrow range of heating rates. This paper presents a novel method to extend the applicability of the first-order single-reaction model over a wide range of heating rates. The two rate parameters in the model, a pre-exponential factor and activation energy, are derived in he form of heating rate dependent functions. The total weight loss data from devolatilization of a Montana lignite over heating rates from ≈0.1 to 10/ sup 4/ C/s were used to illustrate the derivation procedure, and to test the reliability of this method.

14180 An equilibrium-thermodynamic analysis of sulfur release and capture in a gasification/combustion environment. Nagarajan, R. (Dept. of Mechanical and Aerospace Engineering, West Virginia Univ., Morgantown, WV (US)); Khan, M.R.; Pham, H.N.; Anderson, R.J.; Headley, L.C. (U.S. Dept. of Energy-Morgantown Energy Technology Center, Morgantown, WV (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 197-207(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Coal and coal-derived liquids and gases constitute an economically attractive alternative source to liquid petroleum fuels. Ongoing research programs at DOE-METC are currently examining the potential of inexpensive production of clean liquid and solid fuels from coal by mild gasification, and of gaseous fuels by countercurrent, pressurized, fixed-bed gasification. The simultaneous release of gaseous sulfur species (H/sub 2/S, COS, SO/sub 2/, SO/sub 3/) is an inherent environmental limitation to a large-scale practical application of these processes. A computational technique to estimate the release of sulfur from coal and subsequent capture by calcium-based sorbents is presented here, where both processes are assumed to proceed to equilibrium under devolatilization, gasification (reducing), and combustion (oxidizing) conditions. A free-energy minimization computer program (PACKAGE) is used here to simulate local thermochemical equilibria in these reactive atmospheres. Predicted partial pressures of sulfur species are compared with experimental data on sulfur release and sorption, and conclusions are drawn regarding the usefulness and limitations of an equilibrium approach to modeling these processes.

14181 Separation of gas mixtures by transition-metal complexes. Lilga, M.A.; Hallen, R.T.; Nelson, D.A. (Battelle, Pacific Northwest Lab., P.O. Box 999, Richland, WA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 310-314(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The selective separation or purification of gases, especially hydrogen and CO, is highly desirable in processes utilizing product gas from coal gasification. However, gas separation is a difficult and energy intensive process. The development of new and innovative methodologies to selectively and efficiently separate specific gas components from mixed-gas streams would significantly reduce the cost and complexity of product gas production and processing. For example, efficient H/sub 2/ separation from synthesis gas could make coal an attractive future source of H/sub 2/ for use as a fuel or chemical feedstock. In addition, this technology could have a significant impact on processes not directly associated with coal gasification in which hydrogen is lost in a waste stream. These processes include ammonia manufacture, reduction of metallic oxide ores, and hydrogenation of fats and oils. Thus, wide-ranging applications exist for hydrogen separation and recovery technologies. The Pacific Northwest Laboratory (PNL) is examining transition-metal complexes as selective agents for the separation of syngas components from gas mixtures. Transition-metal complexes are known which react reversibly with gases such as H/sub 2/, CO, O/ sub 2/, and CO/sub 2/. This reversible binding can be used to transfer the gas from a region of high partial pressure to a region of lower partial pressure. The selectivity of transfer is determined primarily by the selectivity of the metal in binding a specific gas. The nature of the ligands surrounding the metal has a large influence on the selectivity and reversibility and the authors have successfully used ligand modification to prepare complexes that have improved properties for H/sub 2/ or CO binding. Applications of metal complexes to gas separation and two specific examples of metal complexes under study are discussed.

14182 Removal of hydrogen chloride from high temperature coal gases. Krishnan, G.N.; Wood, B.J.; Tong, G.T. (SRI International, 333 Ravenswood Avenue, Menlo Park, CA (US)); Kothari, V.P. (U.S. Dept. of Energy, Morgantown Energy Technology Center, 3600 Collins Ferry Road, Morgantown, WV (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 292-299(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The chlorine content of U.S. coals ranges from 0.01 to 0.5%, and some coals in U.K. contain as high as 1.0% chlorine. This element is present in the coal mainly as alkali chlorides, but it also occurs as oxychlorides of calcium and magnesium. The presence of HCl in the coal gas can lead to corrosion of metallic and ceramic components of the gasifier, attack gas turbine components and to poisoning of molten carbonate fuel cell electrodes. Morgantown Energy Technology Center, as the U.S. Department of Energy's lead center for coal gasification and gas stream cleanup technology, has been concerned for some years with the purification of coal-derived gases for a range of applications including gas turbine, fuel-cell, and combined-cycle po[illegible] generation. This paper presents the results of a laboratory-sc[illegible] evaluation conducted at SRI International to determine the effectiveness of naturally occurring minerals and commercially available sorbents to remove HCl vapor from

simulated coal gas streams at temperatures from 550° to 650°C. The thermodynamic stability and the volatility of the solid chloride products were the major criteria in selecting the nature of the sorbent. Alkaline earth chlorides, generally, are less volatile than alkali metal chlorides and transition metal. Bench-scale experiments were also conducted with these sorbents at the Institute of Gas Technology, Chicago, IL. The rate of chloride uptake was calculated from the analysis of the chloride content of the spent sorbent as a function of the bed depth. The results of bench-scale experiments were in general agreement with the laboratory-scale experiments although the HCl removal rate and the chloride capacities were somewhat lower than found in the laboratory-scale experiments.

14183 **A mechanistic model for axisymmetric cavity growth during underground coal gasification.** Britton, J.A.; Thorsness, C.B. (Lawrence Livermore National Lab., P.O. Box 808, L-367, Livermore, CA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 126-137(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Underground coal gasification (UCG) is a process in which coal energy is recovered without mining by artificially enhancing gas permeability in a section of a coal seam, igniting the coal remotely, partially combusting and gasifying coal by means of injected oxygen-steam-air mixtures, and collecting the product gas for cleanup and processing for a variety of end uses. The technology has been the subject of active field, laboratory and modeling research in the U.S. and Europe for more than 15 years, and during this time significant advances have been made and the process is nearing commercialization. The model described in this paper applies to flat-seam UCG of subbituminous or lower rank coals in which the oxidant injection point remains low in the coal seam, and has progressed, the authors feel, to the point where it has become a useful tool with predictive ability for these conditions. It is based on a few key assumptions which are difficult to verify fully at the scale of interest, but which seem to be justified by model comparisons with field data.

14184 **Continuous kinetic lumping for lignite liquefaction.** Moore, P.K.; Anthony, R.G. (Dept. of Chemical Engineering, Texas A and M Univ., College Station, TX (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 157-164(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The need for an alternative energy source to counteract both short-term petroleum supply interruptions and the eventual depletion of petroleum reserves has resulted in an increased interest in the utilization of domestic coal. While coal can be utilized directly for energy applications such as electrical power generation, much of the petroleum demand is based in the liquid fuel and liquid feedstock areas. This potential demand for liquid fuel and feedstock has caused a renewed interest in coal liquefaction technology. However, the development of coal liquefaction technology to an industrially applicable level has been hindered by the lack of a suitable kinetic model. Current kinetic models are based upon simplified analytical techniques in which components are lumped into several solubility or volatility classes. The development of such a kinetic model is the goal of the coal liquefaction studies at Texas A and M University. Any attempt to improve the kinetic model must therefore effect an improvement in one or more of the supporting areas. The coal liquefaction research at Texas A and M University has resulted in significant advances in the areas of analytical technique, component lumping, and reactor modeling, thus providing the foundations for the development of a powerful new kinetic model. This paper describes the results which have been achieved and the course of the research now being followed in each of the supportive areas: experimental reactions, analytical method, component lumping, reactor modeling, and parameter estimation.

14185 **Studies of catalytic upgrading of low-severity liquefaction products from low-rank coals.** Olson, E.S.; Diehl, J.W.; Sharma, R. (Univ. of North Dakota Energy and Mineral Research Center, P.O. Box 8213, University Station, Grand Forks, ND (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 332-338(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The optimal liquefaction conditions for low-rank coals appear to be the use of a two stage process, where relatively low temperatures (380°) are used in the first stage because of the higher reactivity of low-rank coals and the tendency to coke at higher temperatures. This low-severity product can then be subjected to a secondary upgrading process to give a better fuel product. This paper is concerned with the catalytic hydrotreatment of a low-severity product obtained from the liquefaction of a Wyodak subbituminous coal in tetralin solvent at 384°C (1 hour) in carbon monoxide plus hydrogen sulfide. The low-severity product was separated into two fractions, a methylene chloride soluble fraction and methylene chloride insoluble fraction. The results from second stage liquefaction of the methylene chloride soluble fraction under various conditions will be reported here. This fraction comprised the major portion of the low-severity product. The second stage reaction used the same solvent as the first stage. This solvent was chosen because it does not contain oxygen and is a simple system whose products, naphthalene, decalin, methylindan, butyl benzene and dimers, can be easily distinguished in the reaction products. Two reaction temperatures (425°C and 450°C) were used in the high severity treatments. Runs for one or two hours were conducted. Hydrogen pressure was another variable during these investigations, although all reactions contained the same amount of the sulfided Co-Moly catalyst.

14186 **Origins and reactions of alkyls and alkanes in direct coal liquefaction.** Moroni, E.C. (U.S. Dept. of Energy, FE-25 GTN, Washington, DC (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 384-386(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Recent analytical methods have attempted to unveil the nature of the aliphatic part of the molecules present in coal structures, and, with some approximation, they were successful in determining the origins and the size distribution of the alkyl chains and of the linear hydrocarbons. The abundant presence of alkyl groups have been observed among the products of thermal and donor solvent dissolution reactions of various coals. While the analytical determination of alkyls presence in the products of coal conversion and the speculation of their original status in the coal matrix have been extensively studied, their roles in the various reactions occurring in coal liquefaction have not received adequate attention by the research community. For a more fundamental approach in coal liquefaction there is an opportunity to study the reactions occurring at the low temperature ranges, say 250-380°C, for each of the reactive components, or each group of components present in coal or formed in the initial stages of liquefaction, which can be related to the most significant beneficial effects observed in the staged temperature experiments. This paper presents some of the reactions involving alkyl groups as well as formation of alkanes, which might have important roles in coal liquefaction. The paper has the additional objective to stimulate the research community to undertake a more systematic research approach in liquefaction which ought to separate the many reactions occurring at the lower temperature range from the subsequent reactions occurring at the higher temperatures.

14187 **Thermal and kinetic study of the mild pyrolysis of single subbituminous coal particles.** Huang, G.; Vastola, F.J.; Scaroni, A.W. (The Pennsylvania State Univ., The Combustion Lab., 404 Academic Activities Building, University Park, PA (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 283-294(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A detailed knowledge of coal pyrolysis is fundamental to the understanding of the early stages of many coal conversion processes. Pyrolysis studies have been conducted using a variety of techniques including the use of electric grids, thermogravimetric analyzers, entrained flow reactors (7-9), and fluidized beds. In order to eliminate the complexity introduced by particle interactions, some research has been directed towards the behavior of single coal particles. Others have measured the transient temperature gradients in the gas surrounding a captive 1 mm diameter coal particle with a fast response thermocouple array and found steep gradients up to 4 mm from the surface. Others have reported on differences between high temperature devolatilization in air and N/sub 2/ for 2-4 mm-sized particles, and conducted an isothermal kinetic analysis of the data. Others have analyzed experimental data from laser-heated coal pyrolysis experiments and concluded that the pyrolysis rate was controlled by the heat flux to the particle surface and by thermodynamic transport constraints within the particle. The significance of heat transfer effect on coal pyrolysis were recently reviewed and it is clear that heat transfer plays an important role. Nevertheless, few references can be found in the literature on the instantaneous rate of heat transfer to pyrolyzing coal particles. Most measurements in this area have been made using Differential Scanning Calorimetry (DSC) which is limited to low heat fluxes during the heatup to pyrolysis temperature. The current work is an attempt to relate experimentally measured particle temperature and mild pyrolysis rates in order to determine meaningful kinetic parameters.

14188 **Pyrolysis of a binary hydrocarbon mixture.** Savage, P.E. (Dept. of Chemical Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 250-256(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Numerous pyrolyses of coal model compounds have provided substantial insight into the thermal reactions of the moieties they mimicked. The results of experiments with single compounds, however, provide no information about the interactions that can occur between the distinct chemical components in complex reactants such as coal. Because an active center (e.g., free radical) derived from one chemical moiety can react with a second, different moiety, reaction pathways that are important for the pyrolysis of a single model compound might not be equally important for the model-compound-like moiety in a coal macromolecule. Conversely, pathways unobserved in single-component pyrolyses might be operative in coal pyrolysis. Previous reports of the pyrolysis of binary mixtures of high-molecular-weight compounds, though few demonstrated that reactions between active centers derived from the two different compounds or between an active center from one compound and the second compound itself can affect the reaction rates, product selectivities, and reaction pathways. They suggested that an aromatic displacement reaction with atomic hydrogen (formed from dialin decomposition) was responsible for the accelerated bridge decomposition. To gain additional insight into the pyrolysis of binary mixtures of high-molecular-weight compounds, a reaction model has been developed in this paper to simulate the copyrolysis of tetradecyibenzene (TDB) and dodecylcyclohexane (DDC). These compounds mimic alkylaromatic and alkylnaphthenic moieties in coal and asphaltenes.

14189 **Pyrolysis of compounds containing polycyclic aromatic moieties.** Javanmardian, M.; Smith, P.J.; Savage, P.E. (Dept. of Chemical Engineering, Univ. of Michigan, Ann Arbor, MI (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 242-249(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Coal is thought to exist in a complex, cross-linked, macromolecular framework in which polycyclic moieties are covalently linked together by aliphatic and heteroatomic bridges. The condensed aromatic groups can also bear peripheral, non-bridging moieties, including long aliphatic chains. The pryolysis of numerous compounds mimicking these structural features has provided considerable insight to the thermal reactions of coal. Previous pyrolyses were typically of compounds containing a single aromatic ring, which was intended to mimic the more massive condensed aromatic moieties in coal. It is possible, however, that single-ring compounds might not display the same reaction pathways and kinetics as otherwise identical compounds containing polycyclic aromatic moieties. One difference between a single aromatic ring and the condensed aromatic moieties in coal is their sizes. This difference suggests that the model-compound-derived free radicals could be considerably more mobile than their coal-derived counterparts. To probe the influence of radical mobility on pyrolysis pathways Poutsma and coworkers pyrolysed coal model compounds immobilized on silica surfaces. They found that surface immbolization can lead to an enhancement of unimolecular pathways relative to bimolecular ones. In an attempt to gain additional insight into the fundamentals of coal pyrolysis, and particularly the effects of condensed aromatics, they recently initiated experiments with compounds containing polycyclic aromatic moieties, which better represent the aromatic clusters in coal than do single-ring compounds. In this paper, the authors report on the pyrolysis of two compounds; 2-(3-phenylpropyl)-naphthalene (PPN), and 1-dodecylpyrene (DDP).

14190 **Rapid evaluation of reaction conditions on coal pyrolyzates using coupled pyrolysis GC/MS.** Miller, D.J.; Hawthorne, S.B.; Timpe, R.C. (Univ. of North Dakota Energy and Minerals Research Center, Box 8213, University Station, Grand Forks, ND (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 455-462(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The optimization of processes using coal as a carbon source for reaction with steam to produce hydrogen requires an understanding of the composition of the volatile components released during the charring process. A coupled pyrolysis GC/MS method has been developed to rapidly evaluate the effect of reaction conditions, including catalysts used to accelerate the char-steam reaction on the composition of the coal pyrolyzate. Four samples (one uncatalyzed and three catalyzed with 10 wt% CaCO/sub 3/, K/sub 2/CO/sub 3/, and Na/sub 2/CO/sub 3/, respectively) of a North Dakota (Velva) lignite were pyrolized under helium at 700°C for ten minutes. The volatile products (primarily benzene and alkylbenzenes, phenol and alkylphenols, dihydroxybenzenes, and methoxyphenols) were spept from the pyrolysis chamber directly into a capillary gas chromatographic column and cryogenically trapped prior to GC/MS analysis. While simulated distillation plots for the uncatalyzed Velva and three catalyzed samples were similar, dramatic reductions in the amounts of catechols and guaiacols were observed in the K/sub 2/CO/sub 3/ and Na/sub 2/CO/sub 3/ catalyzed samples.

14191 **Pyrolysis of the Argonne premium coals under slow heating conditions.** Serio, M.A.; Solomon, P.R.; Carangelo, R.M. (Advanced Fuel Research, Inc., 87 Church St., East Hartford, CT (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 295-309(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The establishment of the Argonne Premium Sample Bank will allow more meaningful comparisons to be made between pyrolysis studies from different laboratories. This sample bank also provides a good suite of coals for examining rank dependent phenomena, such as the kinetics of primary gas evolution. A recent "general" model of coal pyrolysis proposed by our research group has as one of its assumptions that the kinetics of primary product evolution are rank-insensitive. This assumption was tested by a thorough examination of our data from experiments where only coal type was varied as well as data from similar experiments in the literature. The conclusion was that, with few exceptions, the kinetic rate constants for individual species evolved from coals pyrolyzed under the same conditions show little variation with rank. However, this conclusion remains controversial. The Argonne premium samples provide an opportunity to further test this assumption with a set of coals that was designed to cover a wide range of coal types. A slow, constant heating rate experiment was used, which is the most sensitive to rate variations. The authors' own work has indicated a role for heating rate on tar yields for bituminous coals

and on tar molecular weight distributions for lignites. The authors plan to extend this work to the Argonne coals in order to better establish these trends. The current paper is concerned primarily with pyrolysis of the Argonne coals under slow heating conditions in a unique TG-FTIR instrument developed in the authors' laboratory. Results from slow heating rate pyrolysis into a FIMS apparatus are also presented. Experiments have also been done under rapid heating conditions.

14192 **Influence of coal type and pyrolysis temperature on sulfur distribution in products during devolatilization.** Khan, M.R. (U.S. Dept. of Energy, Morgantown Energy Technology Center, P.O. Box 880, Morgantown, WV (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 253-264(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

During coal devolatilization, the coal sulfur is distributed into solid, liquid, and gaseous products depending on the type and quantity of the coal sulfur and the processing conditions (e.g., temperature, pressure, and heating rate) used. In this study, a series of coals was devolatilized at a relatively low temperature in a fixed-bed reactor in an inert atmosphere. The distribution of sulfur in solid, liquid, and gaseous products was monitored. Influence of peak devolatilization temperature on sulfur distribution in products was determined for a high-volatile bituminous coal (Pittsburgh No. 8). The sulfur content of the pyrolysis liquids generated at 500°C correlate well with the total coal sulfur. The total sulfur of the char can be correlated with the pyritic sulfur content of the coal. Total gaseous sulfur content (sum of H/sub 2/S and COS) increases with the increase in pyritic or organic sulfur of coal but direct correlations are poor. An increase in pyrolysis temperature increases the total gaseous sulfur yield. Based on sulfur distribution data for about 25 coals, models have been developed to correlate the sulfur yield in products with the total sulfur of the feed coal.

14193 **The macromolecular structure of coal- Its relationship to diffusion and reaction processes in coals.** Suuberg, E.M.; Otake, Y.; Deevi, S. (Div. of Engineering, Brown Univ., Providence, RI (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 387-394(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Recently, a considerable amount of attention has been directed at understanding how the macromolecular structure of coal influences its reaction behavior. The fact that coal must have a macromolecular structure has been recognized for some time, and has been embodied in many of the "classic models of coal structure. The recognition that coals will behave accordingly naturally accompanied the development of these models. The present paper is concerned mainly with some rather specific aspects of the problem of characterization of the macromolecular structure of coals, and their relationship to key reaction processes and physical properties. The main characterization technique used throughout this work is solvent swelling, as has been used extensively in recent years to characterize the extent of crosslinking in coals. This classic technique was originally developed for examination of crosslinking in polymers.

14194 **Pyrolysis of coals loaded with polycyclic aromatic hydrocarbons.** Malhotra, R.; St. John, G.; Tse, D.S.; McMillen, D.F. (Chemical Kinetics Dept., Chemical Physics Lab., SRI International, 333 Ravenswood Avenue, Menlo Park, CA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 257-261(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The relative simplicity of pyrolysis offers significant advantages as a coal conversion approach. However, char yields are typically high and volatile products are generally distributed between low value light hydrocarbons and tars that can be very difficult to upgrade. Consequently, the pyrolysis of coals under conditions that would produce larger yields of condensible and readily upgradable hydrocarbons is clearly a desirable goal, and the literature contains many examples of approaches to augmenting pyrolysis yields. For this reason, it is desirable that additional efforts be conducted as much as possible in light what is known about the mechanisms of volatiles production. At short reaction times and temperatures below 600°C, the principal impact of H/sub 2/ pressure is to decrease volatile yields, apparently through the impeding of volatiles transport out of the coal and from the pyrolysis region. The lack of any enhancement in volatiles yield is a result of the fact that below 600°C, H/sub 2/, although thermodynamically powerful, is kinetically an ineffective reducing agent owing to the high strength of the H-H bond and the resulting difficulty in thermally achieving significant concentrations of hydrogen atoms.

14195 **A reactor system for studying the interactions between alkali vapors and ceramic compounds.** Shadman, F.; Punjak, W.A. New York, NY; American Institute of Chemical Engineers (1987). 20p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 32E.

The kinetics and mechanism of interaction between alkali vapors and several ceramic compounds are studied. A unique micro-gravimetric reactor is designed and utilized for this study. Bauxite and kaolin are very good adsorbents for alkali chlorides and are potentially good additives for control of alkali during coal combustion and gasification. The experimental data shows that the alkali capturing process is a combination of physisorption, chemisorption and chemical reaction. An analytical model is developed assuming a multi-layer adsorption of alkali on substrate followed by a rate-controlling rection on the surface. The experimental results and model predictions are in good agreement.

0105 By-products

REFER ALSO TO CITATION(S) 14142, 14177, 14185, 14186, 14192

0106 Properties

REFER ALSO TO CITATION(S) 14126, 14131, 14132, 14135, 14136, 14148, 14153, 14161, 14170, 14171, 14175, 14179, 14183, 14184, 14185, 14186, 14188, 14189, 14191, 14192, 14193, 14258, 14266, 14274, 14278, 14283, 14893, 15485, 15563

14196 **(ARC/CR—YCLQ-21) Applied coal petrology. Part 1. Application of coal petrography in the liquefaction of subbituminous coals and lignites.** Parkash, S.; du Plessis, M.P. (Alberta Research Council, Edmonton (Canada). Coal Research Dept.). 1983. 61p. (CE—02149). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this research is the systematic scanning of Alberta Plains coals from the major coal regions for their petrographic composition, and to develop methods for petrographic analysis of solid residues from liquefaction. The long-term objective is to develop means for predicting the yield of liquid and/or gaseous products, starting from the rank and maceral composition of the raw coal. In the laboratory investigations, ten Alberta subbituminous coals were analyzed petrographically; for comparison, lignites from Texas and North Dakota were also included. In the maceral analysis, advantage was taken of fluorescent-light microscopy to identify auto-luminescent liptinitic macerals. On plotting liquefaction conversion yields of lignites and their density fractions against their huminite (vitrinite) contents, a linear correlation becomes apparent, although at this stage of the research, advocacy of any conversion factor for any maceral group would be premature. Petrographic analyses of liquefaction residues appear to be useful in providing new insights into the liquefaction process. Optical examination has enabled identification of four main categories of residue components: relatively unaltered and thermally altered components; granular residue; and inorganic compounds. Vitrinite (huminite) and liptinite group macerals are the principal reactive constituents of coals. Vitrinite gives rise to a number of products found in the solid

residues; semifusinite solubilizes partially and the unreacted part appears in the residue; and semicoke originates from liquefied vitrinite under severe reaction conditions. 24 refs., 16 figs., 15 tabs.

14197 (AU/ME—YCLQ-4) Coal chemistry - a critical status review. Berkowitz, N. (Alberta Univ., Edmonton (Canada). Dept. of Mineral Engineering). 1981. 54p. (CE—02155). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This review focuses attention on fundamental chemical studies directed toward elucidating the chemical structure of coal, and related investigations more specifically undertaken in support of the technical development of coal liquefaction. Comments, where appropriate, are made on the significance of the data accruing from the work, and to what extent these data and the conclusions drawn from them can be deemed applicable to coals of other regions or geological age. Attention is also drawn to conflicts or inconsistencies that arise when conclusions from a particular study are viewed in the context of other knowledge about coal. It is seen that new information on coal chemistry has largely accrued from application of new or improved instrumental methods of analysis, various depolymerization techniques used to yield coal fragments without altering the molecular core configurations of their precursors, specific oxidation reactions to yield derivatives related to their precursors, and better understanding of the action of solvents on coal. Research on coal liquefaction and coal liquids shows a large number of papers dealing with separation of primary liquefaction products and with the characteristics of variously processed liquid hydrocarbons from pilot operations. Reports of a more general interest are reviewed in the areas of sample preparation, liquefaction mechanisms, criteria or correlations used to predict liquefaction behavior, and the effects of petrographic composition. Recommendations are made for future research. 183 refs.

14198 (CONF-8806310—1) The application of inverse gas chromatography to coals and oxidized coals. Neill, P.H.; Winans, R.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004287/JAW.

From Symposium on polymer characterization by inverse gas chromatography (IGC); Toronto, Canada (5 Jun 1988).

Inverse gas chromatography using methane as a probe is used to determine the physical and chemical alterations that coals and oxidized coals undergo as they are heated from 50 to 450{degree}C. At temperatures less than 120{degree}C retention is dominated by water in the pore structure of the sample. In the intermediate temperature region between 120{degree}C and 350{degree}C pyrolysis high resolution mass spectrometry is used to assign the small transitions that are observed to the loss of small amounts of volatile matter. Giesler plastometry and microdilatometry results are used to show that massive disruption of the coal structure occurs at temperatures above 350{degree}C. The starting temperature and the sorption enthalpy are found to vary in a linear manor with the carbon content and degree of oxidation of the coals in this region. 24 refs., 11 figs.

14199 (CONF-8810279—1) Ultrasonic techniques for measurement of coal slurry viscosity. Sheen, S.H.; Reimann, K.J.; Lawrence, W.P.; Raptis, A.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003955/JAW.

From Institute of Electrical and Electronic Engineering meeting; Chicago, IL, USA (2 Oct 1988).

This paper presents a technical evaluation of ultrasonic methods when they are applied to the measurement of slurry viscosity. The four ultrasonic techniques examined were measurement of attenuation, acoustic impedance, relaxation, and acoustic streaming and cavitation. Acoustic impedance measurements are more sensitive to slurry viscosity than to any other fluid parameter. The three other techniques measure acoustic attenuation, but in different frequency ranges. The direct attenuation measurement technique suffers from the difficulty of extracting the viscous contribution from other effects, especially the thermal effect. The relaxation method requires an operating frequency near 10^9 Hz, which is difficult to achieve at present. Finally, the streaming and cavitation method has not been carefully examined because the technique is based on nonlinear acoustic effects which are not well understood. Results from this study indicate that it is feasible to develop an on-line ultrasonic viscometer based on the measurement of either acoustic impedance or acoustic streaming and cavitation. The paper describes the design and performance of an ultrasonic shear-wave wedge for acoustic impedance measurement. The wedge consists of two interfaces; one in contact with air and the other with slurry. Thus, the wedge is self-calibrating and capable of correcting any error that is due to temperature change. 20 refs., 2 figs., 2 tabs.

14200 (DOE/MC/11076—2655) Analysis of coal tars collected from Rocky Mountain 1 ELW and CRIP modules. Barbour, F.A.; Campbell, S.L.; Covell, J.R. (Western Research Inst., Laramie, WY (USA)). Jun 1988. Contract FC21-86MC11076. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000930/JAW.

Coal tars were sampled as composites from the Extended Linked Well (ELW) and the Controlled Retracting Injection Point (CRIP) product streams of the Rocky Mountain 1 underground coal gasification field test. Analyses were performed for the following chemical and physical properties: (1) density, (2) elemental composition, and (3) simulated distillation. Heating value and molecular weight for each coal tar sample were estimated from the elemental and simulated distillation analyses. Major organic compounds in the coal tars were determined by glass capillary gas chromatography. The following chemical types were extracted from the coal tars: (1) bases; (2) strong acids; (3) weak acids; and (4) neutrals, the non-extractable portion. Each neutral fraction was separated into: (1) saturates, (2) aromatics, and (3) polar aromatics using silica gel column chromatography. 12 refs., 3 figs., 12 tabs.

14201 (DOE/PC/80503—T13) Transport and relaxation processes in supercritical fluids: Technical progress report, October 20, 1988--January 19, 1989. Jonas, J. (Illinois Univ., Urbana (USA). Dept. of Chemistry). 1989. Contract FG22-85PC80503. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005910/JAW.

In this period our efforts concentrated on two main projects. First, we finished the theoretical interpretation of the experimental data on transport and relaxation properties of naphthalene in supercritical fluids. Second, we investigated the intermolecular interactions in the CH_3OH-CO_2 system. 2 tabs.

14202 (DOE/PC/80506—7) Dynamic nuclear polarization in coal characterization: Final technical report. Maciel, G.E. (Colorado State Univ., Fort Collins (USA)). 31 Dec 1988. Contract FG22-85PC80506. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006864/JAW.

The overall goal of this project was the development and application of new NMR techniques, based primarily on dynamic nuclear polarization (DNP), for elucidating organic structural details in coal samples. 1 fig.

14203 (DOE/PC/88924—1) Thermodynamics of the solvent swelling of coal: Technical progress report No. 1, September 1, 1988--December 1, 1988. Green, T.K. (Western Kentucky Univ., Bowling Green (USA). Dept. of Chemistry). [1989]. Contract FG22-88PC88924. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006490/JAW.

Sorption of benzene by the pyridine-extract of Illinois No. 6 coal was studied over a range of relative vapor pressures. The sorption process is characterized by a rapid, initial uptake of benzene, followed by a slow, asymptotic approach to equilibrium. Both the extract and its O-methylated derivative exhibit hysteresis (nonreversible sorption behavior) upon desorption, and not all the benzene can be desorbed at 30{degree}C. Heating to 105{degree}C removes all benzene and the equilibrium sorption value is then reproducible. Flory interaction parameters (ξ) were calculated from the sorption data. The parameters are a strong function of vapor pressure and volume fraction of benzene. Extrapolation of ξ to a relative vapor pressure of 1.0 yields a ξ consistent with the predictions of Flory-Huggins theory.

14204 **(EGG-M—88269) Effects of multivalent cations found in coal on alkali- and biosolubilities.** Quigley, D.R.; Breckenridge, C.R.; Dugan, P.R.; Ward, B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 4p. (CONF-8809269—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005315/JAW.

From Bioprocessing of coal; Los Angeles, CA, USA (25 Sep 1988).

Extraction of low-rank coals with dilute hydrochloric acid resulted in the removal of a small percentage of total ash present. Calcium, and to a lesser extent, aluminum, magnesium and iron were present in acid extracts. Resulting coals were significantly more soluble in dilute alkali and more readily biosolubilized than water treated controls. These data suggest that some of the multivalent cations are present in coals as alkali insoluble complexes and contribute to the structural integrity of the coal. 11 refs., 1 fig., 3 tabs.

14205 (EMR—ER80-8F, pp 87-142) **The importance of peat in the Canadian energy context.** Gupal, F. (Univ. de Sherbrooke, Que.). 1980. (In French). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

Peat, as source of energy and hydrocarbons, is of increased interest in Canada, now that hydrocarbon reserves seem to be insufficient for providing energy needs in the area of transport and chemical processes, and as feedstocks for the chemical industry. The absence of hydrocarbon sources in eastern Canada makes peat attractive as a resource; in effect, properly treated and converted, peat can serve as raw material for many applications, notably the production of synthetic hydrocarbons. This paper begins with estimating the reserves of peat in Canada, the quality of the peat and its energy content, and the geographic distribution of peat deposits. The physical and chemical characteristics of peat are then described. The practical, technical aspects of extraction and preparation of peat are reviewed. Conversion of peat into a variety of products, ranging from metallurgical coke to hydrocarbons, is described with reference to scientific developments relating to pyrolysis, gasification, and liquefaction or hydrogasification. Current achievements in peat conversion are situated in the Canadian context. It is concluded that peat offers considerable potential as an energy source, seeing as the total energy content of this resource is higher than that of estimated petroleum or natural gas reserves. Extraction and preparation of peat for energy use, however, present difficult challenges. 53 refs., 13 tabs.

14206 **(NEI-FI—71) Study of water penetrability of peat for lowering of ground water.** Asikainen, A. (Joensuu Univ. (Finland)). May 1988. 68p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756287/JAW.

Data of water penetrability of peat is required for drying plans for wetlands which will be prepared for peat production, so that strip width and drain depth can be determined. Hydraulic conductivity describes the water penetrability factors of peat. It can be determined by direct measurements on the field or in the laboratory or it may be derived from other physical properties of peat. Direct measurements are somewhat troublesome and time consuming and hence the development of indirect methods are necessary. The aim of this research was to examine the water penetrability factors of peat by direct methods. The research was done as literature survey. The theory of underground water flow was collected from basic works of earth physics to clear up the factors effecting on water flow. The information on measurement of hydraulic conductivity and results of measurements were collected from publications. The results of direct measurements are considered to be more reliable than derived results, although the contain several sources of error. The great dispersion of results also render the decision making. In the laboratory larger values are obtained for hydraulic conductivity than in field tests. The hydraulic conductivity has been tried to be derived from rate of humification, the density, the ash and fiber content and porosity and particular constructions of peat. In the case of sphagum peat the rate of humification and density can be used in rough determination of hydraulic conductivity, but in the case of carex and woody peats they are not suitable. The portion of particles over 0.1 mm of the total mass describes tolerably the hydraulic conductivity. The ash content does not describe water penetrability. The hydraulic conductivity correlates best with partial volume of large pores with several peat types.

14207 **(NP—9770218) Intentional modification of the adsorption behaviour of activated carbons. Final report.** Jockers, R.; Kuehl, H.; Rodde, C. (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.). Abt. Kohlechemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1986. 291p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE89770218/JAW.

Aim of this work was to develop an activated carbon from hard coal, which suits well to the special requirements in waterworks having a good adsorption behavior both for high-molecular and low-molecular substances at low concentrations. For this reason, important parameters in the manufacturing process have been changed: Degree of grinding and of oxidation, quality of the basic product by addition of different raw materials, type and quantity of binder, temperature control and gas composition at low-temperature carbonization and activation. In comparison with a great range of commercial activated carbons this plurality of modified products has been studied extensively. An important part of this work consisted of finding out appropriate characteristics which allow to predict the quality of any activated carbon for this purpose with the knowledge of only some data that can be determined easily. With a particle size <1 mm and an apparent density of about 450 g/l, an activated carbon suits well to the requirements, if the following steps are observed in the manufactoring process of Bergwerksverband: Grinding of hard coal to 90% <20 μm, moderate degree of oxidation, addition of a special soot and low-temperature carbonization and activation in a fluidized bed. (orig.) With 108 refs., 84 tabs., 90 figs.

14208 **(PB—89-128433/XAB) West Virginia coal: guide to ash-fusion characteristics.** (West Virginia Geological and Economic Survey, Morgantown (USA)). Jul 1986. 92p. NTIS, PC A05.

Ash-fusion temperatures for coal affect how efficiently and dependably electricity is generated. The wrong ash fusion could seriously impact the coal-fired utility. This report includes information about the coal-fired utility, the importance of ash-fusion temperatures, and a data base of ash-fusion temperature information for West Virginia coal seams. Maps are included that were developed using the data base, which show the variation of ash-fusion temperatures in the West Virginia coal seams.

14209 **Aromatic structures in whole coals and coal macerals.** Winans, R.E.; Hayatsu, R.; McBeth, R.L.; Scott, R.G.; Botto, R.E. (Chemistry Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 407-414(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

New information on the chemical and physical structure of coals and separated coal minerals strongly suggests that polycyclic aromatics do not dominate the aromatic structure except in the very high-rank coals and in inertinites. Two very different approaches have led to these conclusions. First, a very mild, selective oxidation method has ben used to break down the coal macromolecular structure into molecules which can be readily characterized. The products are dominated by single ring aromatics. Second, small-angle neutron scattering has been used to study solvent swollen coals. There is no evidence from the scattering data for the existence of a layered structure, instead long tubular pores are being formed apparently as a result of changes in the hydrogen-bonding in the matrix.

14210 **Prediction of the composition of coal tars from the pyrolysis mass spectra of the parent coals using canonical correlation techniques.** Chakravarty, T.; Meuzelaar, H.L.C.; Jones, P.R. (Biomaterials Profiling Center, Univ. of Utah, Salt Lake City, UT (US)); Khan, M.R. (Morgantown Energy Technology Center, Morgantown, WV (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 235-241(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

In this study, the authors show that the mass spectrometric composition of coal tars can be predicted from the pyrolysis mass spectra of their parent coals. Curie-point low voltage electron ionization mass spectrometry (CuPy-EIMS) was performed on nineteen coals and on their respective pyrolysis liquids prepared by means of fixed bed reactor method described elsewhere. Using factor and discriminant analysis techniques, the spectra can be classified and underlying structural variables responsible for the above classification identified. Furthermore, compositional similarities and dissimilarities between the solid samples and their liquids can be brought out using canonical correlation methods. This paper lists the samples, their PSOC numbers, geological origin and the rank information. Of the nineteen coal samples, two are of subbituminous rank, three of high volatile B and C bituminous rank and the remainder of high volatile A bituminous rank. Twelve coals are from the Eastern/Appalachian coal province, six are from the Interior province and one is a Western coal from the Northern Great Plains province.

14211 **Correlation between refractive indices and other fuel-related physical/chemical properties of pyrolysis liquids derived from coal, oil shale, and tar sand.** Khan, M.R. (U.S. Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 223-234(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

In the literature, characterization techniques based upon the liquid's refractive index are used with petroleum distillates to predict fuel-related properties: however, essentially nothing has been reported on the application of this technique to pyrolysis liquids. Measurements of the refractive indices of the pyrolysis liquids derived from various feedstocks (coal, oil shale, and tar sand) were made and appear to correlate well with the liquids' physical and chemical properties. The refractive indices of the pyrolysis liquids show good correlations with liquid density (correlation coefficient of 0.98), carbon and proton aromaticities (correlation coefficients of 0.88 and 0.91, respectively), and liquid carbon residue (i.e., correlation coefficient of 0.88 with the Conradson carbon residue). The above and other correlations were developed using data from at least 7 to as many as 35 discrete samples. These correlations have been used to develop empirical models. These findings demonstrate the potential of using the liquid's refractive index as a rapid technique to characterize the fuel-related properties of fossil fuel liquids generated by pyrolysis (before they are hydrogenated).

14212 **The comparison of a lignite char, subbituminous coal char, and a bituminous coal char used in the reaction with steam to produce hydrogen.** Timpe, R.C.; Sears, R.E. (Univ. of North Dakota Energy and Minerals Research Center, Grand Forks, ND (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 359-367(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The use of coal as a carbon source in the char-steam reaction to produce hydrogen gas over the temperature range 700°-800°C (973-1073K) at atmospheric pressure has been studied in detail. Velva lignite has properties which give its char superior reactivity over those of the other coals tested. Catalysis with alkali carbonated enhanced the reactivity of Velva char substantially, whereas demineralization reduced the reactivity to a relatively constant value over the temperature range studied by removing inorganic material and altering the surface characteristics of the coal. Char produced from a Wyodak subbituminous coal and River King bituminous coal were much less reactive than Velva in the absence of catalyst but responded positively to the addition of alkali carbonates. Upon demineralization, these coals also showed reduced reactivity and altered surface features. This paper discusses the results of the experiments in terms of the reactivity data, SEM photos and elemental mapping, organic properties as determined from 13C NMR and ESCA spectroscopy, and inorganic content of the substrates.

14213 **A new determination of exchangeable oxygen in coals.** Olson, E.S.; Diehl, J.W. (Univ. of North Dakota Energy and Mineral Research Center, Box 8213, University Station, Grand Forks, ND (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 415-421(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

All facets of research on a coal sample require accurate knowledge of the moisture content, which obviously changes during and chemical or physical processing. The elemental analysis of coal significantly depends on the determination of the moisture content of the coal; and thus during the combustion (ultimate) analysis of a sample, the amount of water initially present in the coal sample must be accounted for in the water of combustion measure in the experiment, in order to determine the amount of hydrogen present in the coal sample. The amount of water present also must be known to determine the oxygen content. Although the weight loss drying method is standard practice for determining moisture, there are errors possible, especially in the low-rank coals, which may contain over 30 percent moisture. These errors could be due to incomplete drying or possibly oxidation during the determination. The mass spectrometers available in the authors' laboratories are not adaptable to analysis of the CO/sub 2/, hence they sought an alternative for the analysis of the isotope ratio in the isotopically equilibrated water samples. The reaction of the water with several orthoesters to give the ester containing the water-derived oxygen (labeled oxygen) in the carbonyl group was investigated. The orthoester selected for the analysis was trimethyl ortobenzoate, since it gave methyl benzoate which could be conveniently analyzed in the authors' GC/FTIR/MS system.

14214 **Determination of compound class composition of oil fractions of some coal liquids by analytical liquid chromatography.** Chawla, B.; Davis, B.H. (Kentucky Energy Cabinet Lab., P.O. Box 13015, Lexington, KY (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 440-448(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A high-performance liquid chromatography method was developed to determine the amount of each of the compound classes (such as saturates, aromatics and polars) in the oil fraction (pentane soluble fraction) of coal liquids. The method utilizes bonded cyanosilane and aminocyanosilance columns and mixtures of benzene in n-hexane and tetraydrofuran in methyl tert-butyl ether as mobile phases. A Tracor LC-rotating disc flame ionization detector was used to quantify the chromatographic peaks. Oil fractions derived from different rank coals, liquefied at 385° and 445°C, were analyzed for their compound class compositions. The trends in the percentages of saturates, aromatics and polars varied with liquefaction temperature and coal rank.

14215 **EXAFS investigation of organic sulfur in coal.** Huffman, G.P.; Huggins, F.E.; Shah, N.; Bhattacharyya, D. (Univ. of Kentucky, 401 Patterson Office Tower, Lexington, KY (US)); Pugmire, R.J. (Univ. of Utah, Fuel Science Dept., Salt Lake City, UT (US)); Davis, B. (Kentucky Energy Cabinet Lab., Lexington, KY (US)); Lytle, F.W.; Greegor, R.B. (The Boeing Co., Seattle, WA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 200-208(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

EXAFS spectroscopy is shown to be a very promising technique for investigating the molecular structure of organically bound sulfur in coal and coal derivatives. The current paper presents

sulfur K-shell EXAFS results for a number of a maceral separates prepared by density gradient centrifugation and for several biodesulfurized coals. Both the near-edge structure and the radial structure functions exhibit some similarities to dibenzothiophene. However, a broad peak occurs in the XANES region of the coal spectra that is not observed for the molecular structures usually ascribed to organic sulfur in coal. This is believed to arise from resonant photoelectron scattering from second and third nearest neighbor carbon shells and from sulfur bonded to oxygen.

14216 **Interrelationships between coal analysis, coal conversion and coal structure.** Finseth, D.; Bockrath, B. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 395-399(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Models for the average structure of a coal and for its chemistry both rely heavily on analyses that are subject to considerable errors. In addition to these analytical problems, it is often true that our notions concerning the "reasonableness" of a chemical reaction of a coal are influenced by our conception of what an average structure for that coal looks like. This picture of an average structure for a coal was in turn probably influenced by analytical results obtained for extracts and/or products of "mild" reaction conditions. These two factors - the weakness of analytical techniques for solid coal, and the somewhat circular dependence of our concept of coal structure on coal chemistry - present problems for studies of both coal structure and coal chemistry. The input data include elemental analyses (C,H,N,O,S), possibly an aromaticity from 13C NMR, and often some characterization data on extracts or mild-reaction products. Recent work at PETC has used the equilibration of cis- and trans-decalin as a probe of the time-averaged steady-state concentration of radicals in complex coal liquefaction systems. A greater steady-state concentration of radicals results in a more rapid conversion of pure cis-decalin to the equilibrium mixture of cis and trans isomers. In this chemical-probe approach, only a small amount of a pure compound is added to the liquefaction feedstock. Because the chemistry of complex liquefaction systems is not likely to be perturbed by a small amount of additive, the chemical probe method has the potential to yield more relevant information than that from investigation of reactions in which a model compound is the sole or the predominant reactant. The decalin isomerization probe has been used to determine the steady-state concentration of free radicals in coal liquefaction using heavy petroleum resid as vehicle.

14217 **Chemical characteristics of tars produced in a novel low severity, entrained flow reactor.** Freihaut, J.D.; Proscia, W.M.; Seery, D.J. (United Technologies Research Center, East Hartford, CT (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 262-282(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The distribution of the light gases and chemical characteristics of the collected tars are dependent on the both the transient particle temperature and ambient gas temperature. A number of investigators have reported that a range of coal types follows the same phenomenological sequence, although the tar yields vary significantly with coal rank characteristics. Moreover, chemical structural characteristics of "primary" tars are reported "similar" to those present in the parent coal, that is, the tar "monomers" reflect the coal "polymer". "Primary" tars are those collected in conditions in which "secondary" reactions have been minimized. Tars collected in these conditions, particularly tars collected in separation systems without extensive phase separation, will appear to be more like the parent coal than the primary tars originally evolved and collected in the above reactor system or other systems that minimize secondary tar reactions. The phenomenological sequence of heavy hydrocarbon formation, tar evolution and gas phase reactions appear similar for a wide range of coals, but the relationship between the chemical structures of primary tars and parent coal varies widely with coal type.

14218 **Formation and growth of coal ash agglomerates.** Carty, R.H.; Mason, D.M.; Kline, S.D.; Babu, S.P. (Institute of Gas Technology, 3424 South State Street, Chicago, IL (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 34-41(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

The behavior of the mineral matter of coal and its reaction product, ash, is of concern in gasification processes because it governs deposition on gasifier and downstream surfaces as well as agglomeration in ash-agglomerating gasifiers. In general, fluidized-bed coal gasifiers operate under backmixed conditions. Consequently, the gasifier solids drain stream could carry with it some unconverted carbon. In contrast, in the KRW and U-GAS processes, the high-velocity jet in the gasifier effectively agglomerates the ash, thereby facilitating its selective removal from the fluidized-bed, and thus achieving carbon conversion in excess of 98%. For the ash-agglomerating fluidized-bed gasifier, the iron oxidation and iron aluminosilicate formation occur in the jet region of the reactor due to its oxidizing atmosphere and elevated temperature. The results of the gasification tests performed in this study indicate that in individual coal particles Fe/sub 2/O/sub 3/ concentrations between 15 and 80 weight percent of the ash promote the formation of ash agglomerates, whereas ash outside this range tends to form free ash rather than agglomerates. In the gasification of coals of low-iron-content ash, significant formation of ash agglomerates can occur by the joining of unmelted mineral matter with relatively small amounts of the iron aluminosilicate matrix material. Characterization of the composition and distribution of the coal ash using the techniques developed in this study could be of assistance in setting the operating conditions of fluidized-bed, ash-agglomerating gasifiers.

14219 **Fine coal beneficiation VIA heavy-liquid cycloning.** Maronde, C.P. (Coal Preparation Div., Pittsburgh Energy Technology Center, U.S. Dept. of Energy (US));. pp v of Proceedings of coal prep 88. Aurora, CO; Industrial Presentations West (1988). (CONF-8803144—).

From Coal Prep '88; Lexington, KY, USA (22 Mar 1988).

Using Freon-113 as the separating liquid in a small-diameter (2.0-inch) cyclone, tests were performed to evaluate the effects of feed inlet pressure (5-65 psi), feed solids concentration (5-25%), feed surface moisture content (0-20%), and Aerosol OT-100 surfactant addition (0-20 lb/ton) on the separation efficiency of the cyclone when beneficiating a 28 mesh x 0 feed coal. Results demonstrated the technical feasibility of achieving sharp separations on fine-size coal via heavy-liquid cycloning, with ash and pyritic sulfur reductions of up to 63% and 76%, respectively. Distribution curve analysis of nine tests showed that separations produced probable errors ranging from 0.103 to 0.221. Distribution curve analysis of three individual size fractions from a 28 mesh x 0 feed coal showed excellent separations of the 28 x 100 mesh and 100 x 400 mesh fractions, with probable errors of 0.024 and 0.054, respectively. Results also indicated that feed surface moisture content had the greatest effect on separation efficiency; a 5% feed surface moisture produced the best separations.

14220 **A group contribution and equation of state approach for coal fluid calorimetric properties.** Hulvey, R.D.; Peters, M.W.; Li, M.H.; Mallinson, R.G.; Starling, K.E. New York, NY; American Institute of Chemical Engineers (1987). 22p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 139D.

This work examines the relationship between the calorimetric properties of coal fluids and their molecular functional group composition. A set of functional groups appropriate for the characterization of the coal fluids is proposed. Coal fluid samples which have had their calorimetric properties measured have been characterized using proton NMR, IR and elemental analysis. These characterizations are then used in a chemical structural model to determine the composition of the coal liquid in terms of the proposed functional groups. These functional group concentrations are used

to estimate the ideal gas calorimetric properties of the fluid using Benson's method. The residual calorimetric properties are then determined using an existing equation of state methodology. The result of the combination of characterization and correlation demonstrates a significant improvement over the existing equation of state based properties estimation system.

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REFER ALSO TO CITATION(S) 14124, 14128, 14134, 14177, 14271, 14297, 15170

14221 **(DOE/FE—0115-3) Coal-based gas stream cleanup program: Fiscal year 1989 summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006812/JAW.

Program plans of the Office of Coal Technology on gas stream cleanup are described. Included is a technology description, status, market applications, program strategy and management, cleanup of gas streams from coal gasification combined cycle, pressurized fluidized-bed combustors, and direct coal-fueled turbines is addressed. CBS

14222 **(DOE/FE—0115-5) Waste management program: Fiscal year 1989 summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006810/JAW.

Program plans of the office of coal technology in management of waste from coal utilization are briefly described. Included is a technology description, status, market applications, program strategy and management. (CBS)

14223 **(DOE/FE—0115-9) Flue Gas Cleanup Program: Fiscal year 1989, Summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006692/JAW.

Program plans of the Office of Coal Technology in flue gas cleanup are presented. A technology description, status, market applications, program strategy and management are discussed. 1 fig., 3 tabs. (CBS)

14224 **(DOE/METC—89/6099) Gas stream cleanup papers from DOE/METC sponsored contractors review meetings in 1988.** Bedick, R.C.; Kothari, V.P. (eds.). (USDOE Morgantown Energy Technology Center, WV). Oct 1988. 385p. NTIS, PC A17/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000901/JAW.

This document contains gas stream cleanup papers that were presented at two contractors review meetings sponsored by the Morgantown Energy Technology Center of the US Department of Energy in 1988. The two meetings were (1) the Eighth Annual Gasification and Gas Stream Cleanup Systems Contractors Review Meeting held May 10-12, 1988, and (2) the Annual Coal Fuel Heat Engines and Gas Stream Cleanup Systems Contractors Review Meeting held June 14-16, 1988. The purpose of the meetings was to present recent technical information on selected projects in the gasification, heat engines, and gas stream cleanup programs. The meetings provided a forum for the exchange and dissemination of gasification, heat engine, and gas stream cleanup research results generated under the sponsorship of the Department of Energy. The gas stream cleanup program was discussed in combination with the gasification and heat engines programs to emphasize the importance of approaching research on gas stream cleanup concepts from a system perspective. Gas stream cleanup is an integral part of all coal conversion technologies. Individual papers are processed separately for the data bases.

14225 **(DOE/PC/88873—T1) Global approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Work plan: Volume 1, Literature review.** (Energy and Environmental Research Corp., Irvine, CA (USA)). 1 Oct 1988. Contract AC22-88PC88873. 106p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006495/JAW.

This document is a review of the available literature pertaining to in-duct SO_2 capture. While it attempts to present the data and conclusions of the most recent and most important experimental studies on the subject, the following sections actually go much farther. EER's current model for in-duct capture is applied to a synthesis of the existing database in Section 3.0. A review is also provided of the various physical, chemical, thermodynamic and transport properties which must be considered when modeling in-duct capture. These are provided in Section 4.0. A review of other process models is presented in Section 5.0. Finally, Section 6.0 attempts to define the gaps in the existing database and identify the research needs which must be fulfilled in order to advance the current understanding of in-duct capture toward predictive modeling and process optimization. 70 refs., 30 figs., 17 tabs.

14226 **(EPRI-EA—5923) Field investigation of a flue gas desulfurization (FGD) sludge disposal site: Final report.** Rai, D.; Zachara, J.M. (Electric Power Research Inst., Palo Alto, CA (USA); Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 146p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89007013/JAW.

An approximately eight-year-old flue gas desulfurization (FGD) sludge disposal site (100 acres in size) was selected for field measurements carried out in 1986. Field and laboratory methods were developed to preserve the chemical integrity of the samples and to accurately measure pH and redox potentials. A combination of field measurements and laboratory experiments with core samples of sludge and of soils underlying the sludge were used to identify geochemical reactions controlling elemental concentrations in the sludge pore water and solute migration. Results are discussed. 38 refs., 39 figs., 16 tabs.

14227 **(IS-M—605) Solidification of coal cleaning refuse/FGD sludge mixtures.** Meisinger, R.F.; Burnet, G. (Ames Lab., IA (USA)). 1987. Contract W-7405-ENG-82. 21p. (CONF-8704342—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005995/JAW.

From Annual meeting of the Iowa Academy of Science; Grinnell, IA, USA (24 Apr 1987).

EPA source standards require that all power stations for which construction began September 1, 1973 or later be equipped with stack gas SO_2 abatement systems. The most common abatement method in the US is wet scrubbing with a limestone slurry. This is resulting in the production of large amounts of flue gas desulfurization (FGD) sludge and great difficulties in its disposal. This investigation deals with the solidification of FGD sludge and coal cleaning refuse mixtures using a granulation/sintering process that derives most of the energy required from the fuel inherently present in the refuse. The refuse is from the River King coal preparation plant in Freeburg, Illinois, and the sludge from the LaCygne station of the Kansas City Power and Light Company. Characterization of the refuse and sludge, the formation and testing of green granules for durability, small and large scale sintering tests, and preliminary evaluation of the sintered granules using standard leaching and freeze/thaw tests are discussed. 9 refs., 6 figs. 3 tabs.

14228 **(NEI-SE—31) Reduction of sulfur dioxide and nitrogen oxide by injection technique.** Aabom, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Machinery Systems). 1988. 75p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756288/JAW.

The aim of the investigation was to perform full scale tests for SO/sub 2/ and NO/sub x/ reduction in a 170 MW (heat) pulverized coal fired cogeneration plant in Vaesteraas. Dry injection was applied with dolomite (0-10 microns), cyanuric acid (0-20 microns) and urea (0-80 microns). Results: - Dolomite injection, Ca/S = 1.59. Sulfur reduction 42% by coal sulfur percentage = 0.52.

Corresponds to 115 mg/MJ in flue gas. Cost SEK 6.20/MWh. - Cyanuric acid injection. NO reduction 30%. Corresponds to 350 mg NO/sub 2//MJ. Cost SEK 12.90/MWh. - Urea injection. NO reduction 16%. Corresponds to 413 mg NO/sub 2//MJ. Cost SEK 1.80/MWh. A tendency of temperature increase in the boiler convection section was mastered by more frequent soot blowing. (O.S.).

14229 **The conversion of organic sulfur in coal to sulfate using perchloric acid.** McGowan, C.W.; Cates, K.Q. (Dept. of Chemistry, Tennessee Technological Univ., Cookville, TN (US)); Markuszewski, R. (Ames Lab., Iowa State Univ., Ames IA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 225-231(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Based upon the author's previous research in which the variable oxidizing power of perchloric acid (HCl0/sub 4/) was used to determine directly the organic sulfur in coal, it was hoped that this property of HCl0/sub 4/ could be also used to determine different forms of organic sulfur in coal. This preliminary investigation into the usage of HCl0/sub 4/ to delineate between various organic sulfur forms was based on model compounds. Dibenzothiophene, benzothiophene, diphenyl sulfide, 2-napththalenethiol, dibenzyl disulfide, and dioctyl sulfide were oxidized in a Bethge apparatus with HCl0/sub 4/ of varying concentration and boiling point. To insure complete sulfur recovery, gases produced during the reaction were captured in a trap containing hydrogen peroxide. Sulfate was then measured nephelometrically, after precipitation as barium sulfate, in the residual HCl0/sub 4/ solution and in the peroxide trap. No appreciable amount of sulfate was measured for the aromatic compounds until a temperature of 170°C or higher was reached. However, for dibenzyl disulfide and dioctyl sulfide, large amounts of sulfate were measured in the trap, even at lower temperatures. The volatility of these two compounds may be a contributing factor in their high conversion to sulfate.

14230 **Numerical modeling of direct sorbent injection for SO/sub 2/ removal.** Lee, J.J. (The Univ. of Tennessee Space Institute, Tullahoma, TN (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 120-125(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A modeling study of steady, turbulent, reactive multi-phase flow in a duct injection flue gas desulfurization (FGD) system is reported in this paper. The stream-function vorticity method was used in finite difference form. The κ-ϵ model was used for turbulence closure. A simple integrated formulation was employed to compute the behavior of sorbent droplets injected into the fuel gas stream. The sorbent may be injected either as slurry or solution into a hot flue gas, or a dry sorbent may be injected into a cooled and humidified flue gas. A comprehensive heat and mass transfer model was developed to simulate the evaporation of the sorbent droplets and the absorption reaction of SO/sub 2/ in the sorbent droplets. Dissolution kinetics of lime particles within a slurry droplet was also included in this model to determine the overall SO/sub 2/ removal rate. Numerical calculations and comparisons with available experimental data were made and are discussed.

14231 **A durable zinc ferrite sorbent for hot coal gas desulfurization.** Jha, M.C. (AMAX Research and Development Center, 5950 McIntyre Street, Golden, CO (US)); Bossart, S.J. (Morgantown Energy Technology Center, PO Box 880, Morgantown, WV (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

Integrated gasification combined cycle (IGCC) technology appears to be one of the most efficient methods of generating electric power from coal. The process economics can be further improved if the physical and chemical cleanup of the gas is performed at high temperature and high pressure before it enters the heat engine. Work performed by Morgantown Energy Technology Center (METC) and its contractors has demonstrated that a regenerable zinc ferrite sorbent can be used for desulfurization of hot coal gas to a few ppm H/sub 2/S level. Early test work with commercially available zinc ferrite extrudes raised some concern regarding durability of the sorbent in a cyclic long-term operation. Under a METC sponsored project at AMAX, a process has been developed for manufacturing of durable spherical zinc ferrite pellets utilizing a combination of binders and modifiers. These sorbent pellets have demonstrated excellent performance in bench-scale tests. A large batch has been produced for pilot-scale testing.

14232 **A process scheme for H/sub 2/S removal from a fixed-bed gasifier gas stream.** Reuther, R.B.; Bissett, L.A.; Strickland, L.D. New York, NY; American Institute of Chemical Engineers (1987). 40p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 114G.

Integrated Gasification Combined Cycle (IGCC) systems are emerging as an important alternative technology for power generation. Methods to remove hydrogen sulfide from the product gas at elevated temperatures are necessary, however, in order to improve the process thermal efficiency of these systems. Studies with zinc ferrite and certain other metal oxides are showing promise in achieving this goal. However, to be a viable concept, the sulfur dioxide created during regeneration of the solid reactant back to the oxide(s) must be converted into a usable or disposable form. One possible process scheme to accomplish this may be to recycle the regeneration offgas stream to the gasifier where the sulfur dioxide can be captured as calcium sulfate and removed in the ash. This paper reports on activities associated with the development of an integrated process scheme utilizing a pressurized, fixed-bed gasifier coupled with a zinc ferrite desulfurization unit. Results from recent tests at the Morgantown Energy Technolgoy Center in which sulfur dioxide was injected into the bottom of a fixed-bed gasifier show that significant fixation of sulfur in the ash is possible with calcium-based sorbents. However, the capacity of the gasifier to fix sulfur in the ash must surpass a minimum level, which varies with operating parameters, in order for the integrated system to work. Also, the details of the zinc ferrite regeneration operation can have a significant impact upon the viability of the integrated process. Test results and their impact on the operation of an integrated system is discussed.

14233 **Absorption, electrodialysis and additional regeneration in two flue gas SO/sub 2//NO/sub x/ cleanup processes.** Walker, R.J.; Pennline, H.W. New York, NY; American Institute of Chemical Engineers (1987). 34p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 58D.

Eleven potential adsorbents for use in the two processes were tested in a laboratory-scale bubble column. Best absorbent performance was obtained with iron EDTA in an ammonium sulfite/sulfate solution. Removals of greater than 95% were observed for SO/sub 2/, NO, and NO/sub 2/ from a simulated flue gas containing N/sub 2/, O/sub 2/, CO/sub 2/, SO/sub 2/, NO, and NO/sub 2/. Laboratory-scale electrodialysis tests of fresh scrubbing liquor revealed that iron EDTA tended to permeate through anion-selective membranes and thus deleteriously affected process performance. Screening tests with twelve types of anion-selective membranes showed that three had EDTA permeation rates that were acceptable for process operation. Two methods of regeneration with respect to the NO/sub x/-removal component were investigated. Thermal stripping did not appear successful for producing nitrogen oxides in the off-gas from the stripper. A thermal treatment of the spent liquor at 50°C successfully regenerated iron EDTA. The mechanism is being investigated.

14234 **Testing of novel sorbents for H/sub 2/S removal from coal gas.** Gangwal, S.K.; Stogner, J.M.; Harkins, S.M.; Bossart, S.J. New York, NY; American Institute of Chemical Engineers (1987). 30p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 114C.

Application of the regenerable mixed metal oxide, zinc ferrite for removal of H/sub 2/S from hot coal derived gas streams is limited to a maximum temperature of about 1,250°F (677°C) and to a minimum H/sub 2/S concentration of about 5 ppmv in the cleaned gas. Four novel sorbents which have shown potential for overcoming the limitations of zinc ferrite, were selected for development and bench-scale testing. The chemical formulae of these sorbents, which were prepared as strong 3/16" (4.76 mm) extrudates, were 1. (ZnO)/sub 0.86/(CuO)/sub 0.14/(Fe/sub 2/O/sub 3/), 2. (ZnO)/sub 0.8/(TiO/sub 2/), 3. (CuO)/sub 3/(Fe/sub 2/O/sub 3/)(Al/sub 2/O/sub 3/), and 4. (CuO)(Al/sub 2/O/sub 3/). Several variations of these mixed metal oxides were prepared using different amounts of binders and were tested in the presence of simulated coal gas using a thermogravimetric reactor (TGR) for selection of preparations possessing an adequate combination of reactivity, regenerability, capacity and strength. Limited bench-scale tests were conducted in the presence of simulated fluidized-bed coal gasifier product gases at pressures from 1 to 2 MPa, temperatures from 525°C to 625°C and space velocities from 1,000 to 3000 Nm/sup 3//(m/sup 3/ . h). Sorbents 1 and 2 were found to be capable of reducing the H/sub 2/S concentration in coal gas from 1.5 percent to <1 and 7 ppmv, respectively. Sorbent 1 adsorbed 13.5 percent by weight sulfur prior to sulfur breakthrough at 100 ppmv while sorbent 2 adsorbed 7.2 percent prior to breakthrough at 500 ppmv. Little reduction in capacity was apparent for either sorbent over two sulfidation cycles with an interim air-steam regeneration at temperatures up to 800°C.

14235 **Development of zinc ferrite desulfurization sorbents for large-scale testing.** Grindley, T.; Goldsmith, H. New York, NY; American Institute of Chemical Engineers (1987). 41p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 114D.

Hot coal gas desulfurization utilizing zinc ferrite sorbents has high potential for gasifier combined cycle and molten carbonate fuel cell types of applications. This paper presents some of the results of a test program at the Morgantown Energy Technology Center (METC) to develop zinc ferrite sorbents and evaluate them for adequate reactivity and regenerability. The program used a laboratory-scale, fixed-bed reactor operated with a simulated gasifier product gas to screen various sorbent formulations and a bench-scale, fixed-bed reactor located in a sidestream of a fluidized-bed gasifier to test and evaluate the sorbents. To increase durability (i.e., resistance to attrition, decrepitation, etc.) over multiple adsorption and regeneration cycles, it was necessary to add inorganic binders such as bentonite to the zinc ferrite. Several different formulations were tested for retention of reactivity and regenerability in the sidestream reactor. Based on the results, a large batch of the sorbent which exhibited the best performance, including sulfur capacity, crush strength, etc., was supplied by a prominent manufacturer.

14236 **Control of NO/sub x/ and SO/sub 2/ emissions by gas reburning-sorbent injection technology.** Bartok, W.; Folsom, B.A. New York, NY; American Institute of Chemical Engineers (1987). 23p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 115B.

Emissions of oxides of sulfur and nitrogen are thought to be responsible for acid rain deposition. A large number of existing pre-NSPS electric utility boilers fired with Midwestern and Eastern coals would be affected if acid rain control legislation is promulgated. To allow such boilers to meet potential emissions regulations with fuel flexibility and good operability, cost effective retrofit emission control technology is required. Gas Reburning-Sorbent Injection (GR-SI), a combination control technology that could be retrofitted to coal fired utility boilers, could reduce NO/sub x/ and SO/sub 2/ emissions by 60% and 50%, respectively. A field test project has been initiated as part of the DOE's Clean Coal Technology program to demonstrate GR-SI on three pre-NSPS coal fired utility boilers in Illinois. The Gas Research Institute and the State of Illinois are the other participants in this project. The boilers selected are representative of pre-NSPS design types: one each of tangentially, wall, and cyclone fired units will be tested. Gas reburning consists of the staged introduction of fuel, with coal fired in the main heat release zone, and 15-20% of the heat input added as natural gas in the downstream reburn zone. This is followed by the burn-out zone where a dry, calcium based sorbent can also be injected for SO/sub 2/ pick-up. Alternatively, the sorbent may be injected further downstream in the boiler, or into the flue gas duct between the air heater and the precipitator. Following baseline and optimization testing, the GR-SI technology will be demonstrated in one-year field tests at each host site for a total project duration of fifty-four months.

14237 **Cost-effective emission controls for coal-fired power plants.** Rubin, E.S.; Salmento, J.S.; Frey, H.C. New York, NY; American Institute of Chemical Engineers (1987). 16p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 115D.

Integrated environmental control (IEC) concepts involving combined SO/sub 2//NO/sub x/ removal processes in combination with pre-combustion and combustion control methods offer significant potential for more cost-effective emissions control for coal-fired plants. IEC system designs involving three advanced flue gas treatment processes in conjunction with conventional and advanced coal cleaning technologies to achieve overall reductions of 90 percent for both SO/sub 2/ and No/sub x/ are compared to a conventional pulverized coal plant design using currently available technology. A new computer modeling framework is used to characterize key uncertainties, and to evaluate overall performance and cost probabilistically using Monte Carlo methods. Results indicate that several IEC systems currently under development offer a good change of reducing environmental control costs by 20 to 30 percent, although improvements in currently commercial technology are likely to offset some of the gains expected from advanced process designs. The use of probabilistic analysis for research management and utility planning are discussed in the context of the case studies presented.

14238 **Analytical chemistry of polycyclic aromatic hydrocarbons present in coal-fired power plant fly ash.** Tomkins, B.A.; Reagan, R.R.; Maskarinec, M.P.; Harmon, S.H.; Griest, W.H.; Caton, J.E. (Analytical Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

The combination of increased electrical power demand, increased cost of petroleum crude, and ready availability of native coal has assured a key role for coal-fired power plants as sources of electrical power. As the number and generating capability of these plants increases, it becomes even more important that valid analytical methods be developed for determining important pollutants which may be associated with power plant emissions. The presence of polycyclic aromatic hydrocarbons (PAH) on fly ash is of particular concern because some of these species are proven carcinogens. PAH, as well as many other organic species, will likely be adsorbed by the fly as it leaves the stack and is rapidly cooled to ambient temperature. In this paper, the authors describe a method for determining PAH extracted from fly ash, as well as the problems involved in such an analysis. These determinations are complicated not only by the variety and trace level concentrations of the

species present, but also by reactions between the PAH and the surface of the ash.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 14147, 14180, 14226, 14227, 14257, 14276, 14288, 14289, 14290, 14291, 14292, 14293, 14294, 14295

14239 **(DOE/SR/15170—2) Kinetics and mechanisms of the release of trace inorganic contaminants to ground water from coal ash basins on the Savannah River Plant: Progress report, October 1, 1987--September 30, 1988.** (Claflin Coll., Orangeburg, SC (USA)). 31 Aug 1988. Contract FG09-86SR15170. 42p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006368/JAW.

Undisturbed cores of ashes from the sites, randomly selected in the Old and New ash disposal basins, located in D-area on the Savannah River Plant were removed and sequentially extracted for the quantitative estimation of dissolved (pore water), exchangeable, Fe/Mn oxide associated and organic matter associated trace inorganic contaminants (i.e., As, Cd, Cr and Ni). Undisturbed cores of ashes were leached with deionized water, nitric acid (pH3) and calcium hydroxide (pH8) solution to evaluate the kinetics of release of trace metals. The ash samples were also analyzed for total P, K, Na, Ca, Mg, Al, Pb, Mn, F, B, Cu, Zn and Mo. Sluiced water samples, at four locations in the new ash basins, were tested for As, Ca, Cd, Cr, Fe, Mn, and Ni. Ground water samples from wells, installed at the ash sampling sites were tested for Ca, Mg, Na, K, P, Al, Fe, Mn, Ti, Cu, Zn, Ni, Mo, Cd, Si, Cr, Sr, B, Ba, Pb, V, As and Se. A very small fraction of the total elemental concentration, excepting Cd, were found in the dissolved phase. Most of the easily releasable elements in the ashes were found associated with Fe/Mn oxides and organic matter. Analysis of the data clearly indicates the release and mobilization of trace contaminants to the lower horizons of the impounded ashes. Elemental translocation was found to be more serious in the old ash basin. 19 refs., 17 tabs.

14240 **(DOE/SR/18001—1) Development of critical life stage assays: Teratogenic effects of ash basin effluent components on freshwater fish, Gambusia affinis and Daphnia: Progress report, May 21, 1987-- June 1, 1988.** Guram, M.S.; Boatwright, B. (Voorhees Coll., Denmark, SC (USA)). 6 Apr 1988. Contract FG09-87SR18001. 29p. NTIS, PC A03 - OSTI. Order Number DE88011510/JAW.

The Voorhees College research project directed toward describing and evaluating the reproductive activity of a representative fish species (Gambusia) in several ponds on the SRP property has established several important points during the first phase (year I) of its operation. It has been demonstrated that significant numbers of the selected fish can be obtained from each of the test ponds, and can be returned to the Voorhees College laboratories in good physiological condition. This is shown by very minimal loss of fish during and following capture, transportation, and subsequent placement in individual tanks for rearing young when delivered during subsequent weeks. Forty individual fry rearing tanks are now functioning with capture of fry being carried out as they are delivered by each female fish. Preservation of fry is made in Bouins solution for detailed analysis of any abnormalities. The goal of the first phase is to establish a year long (several seasons) profile of the number of fry delivered per female fish, presence or absence of abnormal fry at birth, variation in fry between successive deliveries of fry, variations throughout the year, and variations of fry characteristics between the several ponds from which the adult female fish were obtained. Excellent technical help has been obtained from Voorhees College senior biology major students. These students have maintained the health of the rearing ranks throughout the study period, have collected the fry as they are born, and analyzed data obtained in observations on those fry.

14241 **(IS-M—606) Codisposal of coal solid wastes by a granulation/sintering process.** Gokhale, A.J.; Burnet, G. (Ames Lab., IA (USA)). 1987. Contract W-7405-ENG-82. 19p. (CONF-8704342—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89006401/JAW.

From Annual meeting of the Iowa Academy of Science; Grinnell, IA, USA (24 Apr 1987).

Coal cleaning and combustion wastes pose serious environmental problems due to leaching, dusting and smoldering at disposal sites. The wastes can be stabilized by a granulation/sintering process that yields impervious, vitreous granules resistant to environmental degradation. Work is reported for mixtures of coal cleaning waste and power plant fly ash. The sintering is carried out using principally the energy (fuel) inherently present in the cleaning waste. The cleaning waste is from the River King coal preparation plant in Freeburg, IL and the fly ash from the Ottumwa Power Station, Ottumwa, IA. Characterization of the wastes, grinding of the coal cleaning refuse, the formation and testing of green granules for durability, small- and large-scale sintering tests, and evaluation of the sintered granules using standard leaching and freeze/thaw tests are discussed. 13 refs., 6 figs., 6 tabs.

14242 **(PB—89-123541/XAB) Environmental assessment of peat mining in New York State.** (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Jun 1985. 589p. NTIS, PC E99/MF E99.

Set includes PB—89-123558 through PB—89-123574.

A separate abstract was prepared for each of the three volumes of this set.

14243 **(PB—89-123558/XAB) Environmental assessment of peat mining in New York State. Volume 1. Statewide environmental impact evaluation of peat mining and development. Final report.** Newman, J.R.; Doolittle, J.; Buff, D.A.; Hart, R.; Neff, C.R. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Jun 1985. 320p. NTIS, PC A14/MF A01.

See also Volume 2, PB—89-123566.

This study was designed to provide a detailed evaluation of the environmental impacts of peat mining for New York-specific locations. The project began with a review of the peat regions in the State and postulation of possible regional impacts. The statewide study is listed as volume I. A site-specific investigation was then conducted on a peat deposit at the U.S. Army base in Fort Drum, New York. The results of the study are contained in volume II. Finally, a two-year site-reclamation study was completed to determine the viability of alternative site-reclamation options for mined-out peat deposits; Volume III contains the results of that investigation.

14244 **(PB—89-123566/XAB) Environmental assessment of peat mining in New York State. Volume 2. eat mining demonstration in New York State. Final report.** Doolittle, J.; Pandorf, W.; Deady, M.; Schulz, R.L.; Newman, J.R. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). May 1987. 168p. NTIS, PC A08/MF A01.

See also Volume 1, PB—89-123558 and Volume 3, PB—89-123574.

This study was designed to provide a detailed evaluation of the environmental impacts of peat mining for New York-specific locations. The project began with a review of the peat regions in the State and postulation of possible regional impacts. The statewide study is listed as volume I. A site-specific investigation was then conducted on a peat deposit at the U.S. Army base in Fort Drum, New York. The results of the study are contained in volume II. Finally, a two-year site-reclamation study was completed to determine the viability of alternative site-reclamation options for mined-out peat deposits; Volume III contains the results of that investigation.

14245 **(PB—89-123574/XAB) Environmental assessment of peat mining in New York State. Volume 3. Peat mining reclamation alternatives demonstration in New York State. Final report.** Doolittle, J.; Hart, R.; DeLotelle, R.S.; Newman, J.R. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Jun 1987. 101p. NTIS, PC A06/MF A01.

See also Volume 2, PB—89-123566.

This study was designed to provide a detailed evaluation of the environmental impacts of peat mining for New York-specific locations. The project began with a review of the peat regions in the State and postulation of possible regional impacts. The statewide study is listed as volume I. A site-specific investigation was then

conducted on a peat deposit at the U.S. Army base in Fort Drum, New York. The results of the study are contained in volume II. Finally, a two-year site-reclamation study was completed to determine the viability of alternative site-reclamation options for mined-out peat deposits; Volume III contains the results of that investigation.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 14132, 14136, 14179, 14218, 14283, 14887, 14889

0120 Mining

REFER ALSO TO CITATION(S) 14129

14246 **(CMRC—82/32-T) Compilation of Canadian research projects in coal exploration, mining and preparation 1982.** Chererda, K.; Germain, R. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). 1982. 22p. (CE—02174). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This compilation, which gives project title, objectives and scope, sponsor/contractor, funding, status, and list of reports (if any), is restricted to projects within, or closely associated with, the terms of reference of Alberta's Coal Mining Research Centre. Projects concerning coal mining are listed in three areas: underground, surface, and ground control. Other projects not concerning mining or exploration are listed under the headings of health and safety, and miscellaneous. Geology-type projects are only included if they deal with the problems facing the geologist or engineer in exploring and evaluating a coal property. Mined land reclamation projects are not fully covered, and long distance coal transportation research is only included if it relates to mine-site coal transport or where mine site activities might have a later effect on the transportability of coal.

14247 **(CMRC—82/51-BG) Resin bolt installation in coal.** Green , D.H. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). 1982. 23p. (CE—02169). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An outline of the techniques of resin bolting for use in coal mines is presented. Proper use of such techniques involves consideration of such factors as hole diameter, rebar diameter, resin gel time, resin viscosity, drilling technique, and whether tensioning is used. Recommendations are given for bolt hole diameter and rebar length, choice of gel time, mixing procedure in the hole, storage of resin cartridges, and instruction of personnel. Appendices include manufacturers' specifications and manuals for using resin bolt products.

14248 **(CMRC—8004) Compilation of Canadian coal research projects, exploration - mining - preparation.** Fawcett, D. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). 1980. 24p. (CE—02177). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This compilation of research projects, giving project title, objectives and scope, sponsoring agency, funding, status, and reports published (if any), is restricted to projects that fall within, or are closely associated with, the terms of reference of Alberta's Coal Mining Research Centre. Mining projects are listed in three areas: surface, underground, and ground control. Other projects that do not fit into the areas of mining or exploration are listed under the headings of safety and miscellaneous. Geology-type projects are only included if they deal with the problems facing the geologist or engineer in exploring and evaluating a coal property. Mined land reclamation is not fully covered, and long distance coal transportation research only included if it has some direct application to mine-site transportation of coal, or where mine site activities might have a later effect on the transportability of coal.

14249 **(ITL-JULK—02/87) Potential production of milled peat in Finland based on climatological observations.** Venaelaeinen, A. (Finnish Meteorological Inst., Helsinki). 1987. 33p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756268/JAW.

The use of peat as fuel is increasing in Finland. When planning new power stations using peat as fuel it is important to know how large bog areas are needed to ensure the fuel for the power stations. It has been estimated by the help of climatological data (rain and evaporation) how much peat production can vary in Finland. According to this study the best peat producing areas are in Southern Finland and on the coast of Bothnia Bay. The prospects for peat production are least promising in Northern Finland. An average of 600 m/sup 3//ha of peat is produced in the best areas during one summer. Respectively in the least promising areas during one summer the estimated production is on the average 350 m/sup 3//ha. In the best areas once in ten years the production exceeds 725 m/sup 3//ha and once in ten years the production remains under 450 m/sup 3//ha. In the least promising areas the corresponding figures are 450 and 250 m/sup 3//ha respectively.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 14260, 14283

14250 **(DOE/PC/80524—T12) Pipe and bend erosion by pneumatic transport of solids at high temperature: Quarterly report, March--May 1988.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract FG22-85PC80524. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006247/JAW.

Dead burned dolomite was tested as the third erodent material for pipe bend erosion testing, but it was rejected due to problems in the operation of the test unit. During this period a novel method of sample characterization, based on fractal analysis, was tried for the refractory samples. (JL)

14251 **(DOE/PC/80524—T13) Pipe and bend erosion by pneumatic transport of solids at high temperature: Quarterly report, June--August 1988.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1988. Contract FG22-85PC80524. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006479/JAW.

Blinded T-bends used in pneumatic transport lines are characterized for having a long life. In this work was studied the effect of gas velocity, solids flow rate and bend orientation on the wear and flow patterns inside this kind of bend. Gas velocities up to 30 m/s, in dilute phase conditions were tested in a 2 inch I.D T-bend made of glass. The orientations tried were horizontal to horizontal, horizontal to vertical upwards and vertical upwards to horizontal. The different flow patterns were photographed and the deposition of solids was characterized in a gas velocity-solids flow diagram. Depending on the operating conditions and bend orientation, a wedge of solids accumulated in the dead end zone, resisting the primary impact of the erodent. For the erosion tests, the glass surface was painted, and the wear patterns were determined for different orientations and regimes. 5 refs., 12 figs., 1 tab.

14252 (EMR/E—1976, pp 95-98) **Moving coal to market. A terminal's perspective.** Leach, A.S. (Thunder Bay Terminals Ltd.). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN mimnimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

This paper discusses the one Canadian company's experiences with the transport of coal from Western Canada to eastern Canadian markets. The company is constructing a terminal in Thunder Bay for handling ca 3,500,000 tons of coal per year from 3 Western sources by 1980; this coal will be shipped through the Great Lakes to generating stations in Ontario. The terminal facili-

ties are intended to be expandable to accommodate up to 6 million tons/y. Some major problem areas revealed by experience with this terminal and another one in British Columbia are then outlined. The major problem is cost: not only high capital costs, but costs involved with transportation over long distances, the inventory in transit, financing, amortization, and the need to have a customer whose coal requirement is high enough to be able to guarantee a certain volume over an extended time period. Other problems were experienced in the need for pollution control, in keeping up with changing government policies, and in storing coal over the winter season when Great Lakes shipping is inoperative. All these problems affect the competitiveness of the coal compared for alternative energy sources.

14253 (EMR/E—1976, pp 91-94) **What's new in coal transportation.** Lawless, R.E. (Canadian National Railways). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

Certain aspects of coal transportation in Canada are reviewed from the point of view of a railway company. The unit train concept, a highly successful and efficient means of conveying high-volume commodities such as coal, is discussed. Initially-unknown cost factors were found to have a negative effect on profits from unit train operations: rail and wheel life is reduced, relative to normal train operations. However, the characteristics of the unit train point out the way to increased cost efficiencies. Using identical cars in such trains allows spreading of a very firm volume of fixed costs over more cars. Such cars can be constructed identically, allowing easier maintenance and operation. In view of the foreseeable increase in unit train volume, other improvements in operational efficiency include pooling of equipment to increase flexibility and optimize the train size, and increase effective utilization of trains by carrying a suitable return cargo. A program of increased capital expenditures by Canadian National Railways is outlined. Most of the money spent in this program will be for construction in Western Canada, where most of the train movements associated with the coal industry are located. Research and development is also described concerning a new kind of freight car designed to permit loop track unloading without uncoupling cars in the unit train. Some mention is made of new developments in locomotives, cabooses, scheduling, and unit train contracts.

0140 Combustion

REFER ALSO TO CITATION(S) 14137, 14178, 14182, 14187, 14190, 14195, 14213, 14217, 14221, 14222, 14224, 14238

14254 **(DOE/FE—0115-1) Heat engines program: Fiscal year 1989 summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 38p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006814/JAW.

Program plans of the Office of Coal Technology on heat engines are briefly described. Included is a technology description, status, market applications, program strategy and management. Coal-fueled gas turbines and diesel engines are addressed. (CBS)

14255 **(DOE/FE—0115-8) Pressurized Fluidized-Bed Combustion Program: Fiscal year 1989, Summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006693/JAW.

Program plans of the Office of Coal Technology in pressurized fluidized-bed combustion are presented. A technology description, status, market applications, program strategy and management are included. 1 fig., 4 tabs. (CBS)

14256 **(DOE/FE—0115-10) Advanced Combustion Technology Program: Fiscal year 1989, Summary program plan.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Coal Technology). Jan 1989. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006691/JAW.

Program plans of the Office of Coal Technology in Advanced Combustion are presented. Technology description, status, market applications, program strategy and management are described. 1 fig., 2 tabs. (CBS)

14257 **(DOE/MC/22123—2650) Coal-fueled diesel engine exhaust emissions assessment.** Fanick, E.R.; Ingalls, M.N. (Southwest Research Inst., San Antonio, TX (USA); General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div.). Oct 1987. Contract AC21-85MC22123. 79p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000923/JAW.

The objective of this study is to develop emissions information so that the work on coal-fueled diesel engines will include consideration of their environmental impact and necessary emission controls. Only emissions of hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NO/sub x/), oxides of sulfur (SO/sub x/), and particulates will be considered in this assessment. With the exception of HC, there are ambient air quality standards for each of these pollutants. Hydrocarbons are included because they are considered the major reactant in the formation of photochemical smog. The approach that was followed in assessing the environmental impact of a coal-fueled diesel engine involved estimating the exhaust emissions from such an engine based on actual test results and/or theoretical considerations. These emission levels were then compared with emission levels from a diesel engine application that the coal-fueled diesel could be expected to replace. One of the most probable uses of a coal-fueled diesel engine is in railroad locomotives. Coal-fueled diesel emissions were, therefore, compared to the national impact of current diesel locomotives. This comparison revealed which of the coal-fueled diesel emissions are of concern. A study of available emission control techniques for these emission species then defined possible control strategies and estimated cost of such control strategies. 65 refs., 13 tabs.

14258 **(DOE/PC/80529—T10) Effects of coal structure on pulverized coal combustion processes: Quarterly technical progress report No. 13, 1 October 1988--31 December 1988.** Wells, W.F.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Jan 1989. Contract FG22-85PC80529. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006021/JAW.

The general objective of this study is to define and quantify the relationships between coal composition and structure and associated combustion and conversion behavior for three very different domestic coals of interest. To accomplish this objective, two tasks have been identified. The first is to characterize the virgin coal and the process chars. This will give the necessary information to determine if the char preparation process yields or rates are dependent on coal chemical or physical characteristics. The second task is to measure the high temperature reaction rates of the virgin coals and their derived chars, and to interpret results in light of Task 1. Three coals (lignite, subbituminous, and bituminous) are being processed to provide the following components: (1) organic material extractable from coal by pyridine extraction, (2) the solid residue from this extraction process, and (3) char remaining after a high temperature devolatilization of the virgin coal. The coals and their derived solids will be reacted with air at high temperatures (1300, 1500, and 1700 K) to obtain reactivity data. The reactivity data will then be examined for relationships with the physical and chemical properties. 13 refs., 4 figs.

14259 **(DOE/PC/88937—T1) Experimental studies on group ignition of a cloud of coal particles: Quarterly progress report No. 1, August 16, 1988--November 15, 1988.** Annamalai, K. (Texas A and M Univ., College Station (USA). Dept. of Mechanical Engineering). 8 Nov 1988. Contract FG22-88PC88937. 10p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005566/JAW.

In studies of the ignition and combustion of clouds of particles the feeder system is an important component of the experimental apparatus. The accuracy of the data obtained from the reactor depends greatly on the feeder system's capacity to provide a wide range of stable mass flow rates for a variety of particle sizes. The combustion and ignition of coal/chars is being investigated. Design and modifications to the fuel feeding system of the experimental apparatus is discussed. (CBS)

14260 **(DOE/PC/88937—T2) Experimental studies on group ignition of a cloud of coal particles: Quarterly progress report No. 1, August 16, 1988--November 15, 1988.** Annamalai, K. (Texas A and M Univ., College Station (USA). Dept. of Mechanical Engineering). 8 Nov 1988. Contract FG22-88PC88937. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005814/JAW.

Three basic changes have been made to the fluidized bed coal feeder used by Dahdah. The feeder was constructed of aluminum rather than plexiglass to avoid electrostatic loading of the particles and to accommodate higher bed pressures. The off-take system was provided with a needle valve that gives flexibility to the entire system as it allows stable flows at variable rates and does not clog, regardless of the particle size being used. Finally, a plenum chamber was incorporated to dampen out the effects of air line fluctuations on the feeder behavior. 4 figs.

14261 **(IFRF-F—088/a/5) Evaluation of residence time and temperature distribution in IFRF furnace number 1. Report on the CC 2-1 investigation.** Smart, J.P.; Kimura, N.; Knill, K.J. (International Flame Research Foundation, Ijmuiden (Netherlands)). May 1988. 79p. NTIS (US Sales Only), PC A05. Order Number DE88756175/JAW.

Burnout levels in IFRF furnace no. 1, when firing pulverised coal at 2.5 MWt, are typically worse than those acceptable industrially. This behaviour occurs despite peak flame and furnace exit temperatures being similar to large scale values, and the mean residence times being between 2 and 3 time estimated industrial values. Although boundary conditions of peak flame temperature and furnace exit temperature are similar to industrial values, the temperature/time history of coal particles within the furnace is different. This difference in time/temperature history is believed to result in the observed low burnout levels. The purpose of this investigation was to validate these suggestions. To satisfy the objectives of the investigation, the following was performed: a. Characterisation of the residence time distribution in IFRF Furnace no. 1, and b. Evaluation of the change in furnace temperature distributions by modifications to in-furnace heat extraction profiles. The experiments have shown that IFRF Furnace no. 1 has a residence time distribution that is more complex than may be expected from previous work. The residence time distribution indicated that a significant fraction of the coal may emerge between 340 ms and 1.24 s. This fraction leads to the observed low burnout levels typically measured. Burnout levels were insensitive to heat extraction and temperature distribution. However, NO/sub x/ emissions were observed to be highly sensitive indicating a significant temperature effect on NO/sub x/ formation from volatile fuel-N. 27 figs., 25 refs., 6 tabs., 4 app.

14262 **(IFRF-F—088/a/6) Effect of coal particle size and gun design on NO/sub x/ reduction using an aerodynamically air staged burner. Report on the CC 2-2 trials.** Knill, K.J.; Kimura, N.; Smart, J.P. (International Flame Research Foundation, Ijmuiden (Netherlands)). May 1988. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756176/JAW.

A series of experimental burner design studies have been conducted within the IEA Coal Combustion Sciences Program at the IFRF. The AP 14 an AP 16 trials were used to develop an aerodynamically air staged burner (AASB). An understanding of the complex aerodynamic behaviour associated with effective NO/sub x/ control using internal air staging was developed. The NO/sub x/ emission using the AASB was approximately 320 ppm at optimized operating conditions with a burnout of 98%. A more detailed investigation of the AASB was recommended at temperature/time conditions which closely stimulated a utility boiler. The investigation of the temperature/time history of Furnace no. 1 is the subject of the first part of the CC 2 (CC 2-1) trial. The particle size distribution of the coal was varied in the CC 2-2 trial to determine its effect on carbon burnout and NO/sub x/ reduction. The primary objectives of the CC 2-2 trial was to determine the effect of particle size distribution on NO/sub x/ reduction and carbon burnout using the AASB. The secondary objective was to compare the performance of the oblique injection coal gun with the more standard annular injection coal gun. The coal particle size distribution did not have a significant effect on the NO/sub x/ reduction using an AASB with an annular coal gun. A minimum NO/sub x/ emission of 550 ppm was obtained and the carbon in ash at this condition was 5%. The oblique coal gun was superior to the annular coal gun for NO/sub x/ reduction. In general, the NO/sub x/ emissions were 45 ppm lower firing the fine grind coal than firing normal grind coal. The effects of coal grind and coal gun position were successfully explained in terms of the interaction of the coal particles with the flame internal recirculation zone. 17 figs., 8 refs., 5 tabs.

14263 **(IFRF-F—188/a/4) Characterisation of the combustion performance of a suite of pulverised coals. Report on the CC 1 trials.** Morgan, M.E.; Dekker, J.S. (International Flame Research Foundation, Ijmuiden (Netherlands)). Apr 1988. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756177/JAW.

Pulverized coal combustion equipment has been traditionally designed with very qualitative information about the coal used. However, changing coal supplies and the design of new burner systems have led to the need for more quantitative information. The most important processes in coal combustion are coal pyrolysis and the combustion of the resultant gases and solids. The rate of each of these processes must be known as well as the yield of pyrolysis products. Additionally, information about the effect of environmental factors on these rates and yields must be known. One blend and eight coals with ranks from Anthracite to Lignite were characterized using an isothermal plug-flow reactor (IPFR). The experiments were performed under simulated pulverized coal flame conditions so that the simple phenomenological models could be used to fit the data. The data from this study should be useful for a number of purposes, including the qualitative understanding of coal behavior in pulverized coal burners and the quantitative prediction of pulverized coal flames with detailed mathematical models. The IPFR analysis was shown to be an effective way of generating quantitative information about the characteristics of coal during pulverized coal combustion. The technique of simulating the environment encountered and using simple models was successful. Additionally, a significant amount of specific information about the coals studied was generated. Recommendations are given to improve the technique with the goal of creating a more simple, quick technique for accurate, quantitative data on coal combustion. 34 figs., 42 refs., 23 tabs.

14264 **(IFRF-F—336/a/11) Computations of swirling pulverised coal flames. Report on the MMF 1-2 and MMF 1-3 investigations.** Visser, B.M.; Weber, R. (International Flame Research Foundation, Ijmuiden (Netherlands)). Jun 1988. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756178/JAW.

Recent research on low NO/sub x/ combustion of pulverised coal has concentrated on the use of internal air staging and of fuel rich precombustors. This resulted in development of an Aerodynamically Air Staged Burner (AASB). The experiments indicated that the burner is attractive for industrial applications. In parallel to the semi-industrial scale experiments, the development of a mathematical model of pulverised coal combustion was undertaken. The overall objectives of the mathematical modelling programme are to assess the potential of mathematical modelling for prediction of pulverised coal flames and to apply the tool for scaling of the burner design series (AP) experimental results. The task of model development and validation was split into the following phases: MMF 1-1 (Computations of isothermal swirling vortices); MMF 1-2 (Preliminarily computations of two flames measured in the AP 14 experiments); MMF 1-3 (Computations of pulverised coal flames measured in the AP 16 experiments); MMF 2 (Computations of near burner zone properties of swirling flames with emphasis given to sensitivity of the predictions to model parameters, coal properties and burner scale). Results of the MMF 1-1 investigations have been

already reported. This document reports the findings of the MMF 1-2 and MMF 1-3 investigations. The MMF 2 investigation is currently proceeding. 34 figs., 31 refs., 7 tabs.

14265 (ME/SC—8210) Market potential of CLM [coal-liquid mixtures] in Canada. (Montreal Engineering Co. Ltd., St. Catharines, Ontario (Canada)). 1982. 35p. (CE—02321). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As part of an international study of the potential for utilization of coal-liquid mixtures (CLM), a survey was conducted in Canada to examine the possibility of using CLM in industrial boilers and process heaters. An inventory was compiled of all such boilers and heaters, starting with the Atlantic provinces, which are the largest Canadian users of imported fuel oil and therefore provide a significant field for oil substitution. From the data, oil consumption figures were estimated for future years; from those figures, coal quantities for CLM utilization were then calculated for two cases: all boilers and heaters converted to a 50/50 coal-oil mixture, and all converted to a 75-80 wt% coal/20-25 wt% water mixture. It was found that the boilers and heaters surveyed consumed ca 38 million bbl of fuel oil per year, 65% of that total being consumed in the Atlantic provinces. By industry, pulp and paper was the heaviest user. Total oil saved, according to the two cases above, was 6 million bbl for coal-oil and 16.8 million bbl for the Atlantic provinces alone, per year. Cost benefit analyses are presented for typical cases of boiler conversion: a 100 MW utility boiler, and a 50 million Btu/h industrial boiler. It is shown that, at coal and oil prices assumed, there is a saving in converting to coal-water, with a 3-y payback for the utility boiler and 6.5-y payback for the industrial boiler. Another analysis is performed on a cement plant having two oil-fuelled kilns producing 400,000 tonnes/y. Based on residual oil cost of $30/bbl and coal cost of $45/ton, conversion to coal-oil fuel will result in an annual saving of $140,000 and will pay for itself in 51 months. 13 figs., 7 tabs.

14266 (SAND—89-8201) Coal combustion science: Quarterly progress report, July-September 1988. Hardesty, D.R. (Sandia National Labs., Livermore, CA (USA)). Jan 1989. Contract AC04-76DR00789. 99p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006928/JAW.

The objective of this activity is to support the Office of Fossil Energy in executing research on coal combustion science. Specific tasks include: coal devolatilization, coal char combustion, and fate of mineral matter muring coal combustion. 16 refs., 19 figs., 8 tabs.

14267 (TU/CES—8202) Evaluation of combustion burners for coal containing liquids. Final report. (Technical Univ. of Nova Scotia, Halifax (Canada). Centre for Energy Studies). 1982. 293p. (CE—02323). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As part of a Canadian program to develop systems for combustion of coal-water or coal-oil mixtures, a review was undertaken of worldwide literature and experience with burners able to handle such fuels. Manufacturers of such burners were surveyed and research and development in this area of technology are summarized. Of specific interest was the topic of erosion and/or corrosion on nozzle or burner parts and boiler internals. Experience in a number of test programs identified a major problem in burner nozzle erosion. Burner parts originally designed for oil have been found to deteriorate rapidly. This has resulted in unacceptable service life of burner nozzles manifested by rapidly deteriorating flame characteristics. This erosion is the major impediment to widespread conversion to the new fuel. Canadian combustion testing with coal-liquid mixtures has experienced the same difficulties with burner life, and a review of burner nozzle testing methodology is presented, as well as a list of recommended burner systems and types showing experience or promise. This report also includes an inventory of burner nozzle manufacturers, and the appendix presents manufacturer data on various types of burners. 60 refs., 3 figs., 1 tab.

14268 (VTT-TUTK—567) Evaluation of the combustion behaviour of different coals. Miettinen, M.; Aho, M.; Saastamoinen, J.; Huotari, J. (Valtion Teknillinen Tutkimuskeskus, Jyvaeskylae (Finland). Kotimaisten Polttoaineiden Lab.). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1988. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756319/JAW.

The goal of this project was to develop a methodology based on the properties of coal to predict the combustion characteristics of coals imported to Finland. The main approach was to apply different advanced methods to analyze coal reactivity and to model the initial stages of pyrolysis and combustion. A review of developments on coal combustion behaviour prediction was also carried out. Three different coals were tested. Infrared spectroscopy and traditional fuel analysis were used to compare the structure of the coals studied. Thermogravimetry, flash pyrolysis and an entrained flow reactor were used to evaluate the reactivity of the coals. A mathematical model was developed to calculate the heating, drying, pyrolysis and combustion of a coal particle. The results of the project were promising and a methodology was proposed to evaluate the combustion characteristics of coals imported to Finland. In the first phase of the method laboratory scale tests with FT-IR, traditional and isothermal TG, DSC, and entrained flow reactor are carried out to study the reactivity, emissions and burn-out of the coal. The effects of particle size distribution are calculated with the coal pyrolysis and combustion model. Pilot plant and fullscale tests are carried out if necessary. In the second phase detailed mathematical modelling is used to compute flow and heat transfer phenomena and burn-out in the flame paths of the furnace.

14269 Influence of ash on particle size distribution evolution during coal combustion. Dunn-Rankin, D.; Kerstein, A.R. (Combustion Research Facility, Sandia National Labs., Livermore, CA (US));. *Combustion and Flame;* **74**: No. 2, 207-218(Nov 1988).

In this work the authors describe a numerical model of the evolution of the particle size distribution (PSD) during coal combustion. The model includes burning and fragmentation. The model examines the sensitivity of PSD evolution to different modes of fragmentation by allowing the input of alternative fragmentation scenarios. A highlight of the model formulation is the incorporation of mineral matter as a distinct constituent of the coal. Evolution of the size distribution of mineral matter is modeled explicitly. The authors apply the model to two different initial size distributions, a monodispersion and a power-law distribution similar to that of pulverized coal, each with three alternative modes of fragmentation: no fragmentation, fragmentation into a few relatively large fragments, and fragmentation into a family of fragments covering a wide size range. The simulations suggest that the size distribution of ash particles obtained from an initially monodisperse feedstock is sensitive to the fragmentation scenario; in contrast the ash size distribution is not sensitive to the mode of fragmentation if the initial feedstock is power-law distributed.

14270 Evidence for formation of CO/sub 2/ in the vicinity of burning pulverized carbon particles. Waters, B.J.; Squires, R.G.; Laurendeau, N.M. (Purdue Univ., Coal Research Center, West Lafayette, IN (US)); Mitchell, R.E. (Sandia National Labs., Combustion Research Facility, Livermore, CA (US));. *Combustion and Flame;* **74**: No. 1, 91-106(Oct 1988).

Simultaneous measurements of temperature, size, and velocity for individual spherical carbon particles (100 μm < d/sub rho/ < 160 μm) burning in an entrained-flow reactor were used to calculate overall combustion rates and rate parameters at conditions typical of pulverized-fuel combustors (i.e., particle temperatures from 1400K to 2200K). In addition, particles were collected and the carbon mass loss determined at three residence times in the reactor for seven different sets of bulk O/sub 2/ model fractions (from 0.12 to 0.36) and gas temperatures (from 1300K to 1775K). The measured carbon mass loss was compared to calculations of the particle mass profile based on the overall combustion rate parameters obtained from the experimental particle temperatures. The measured and calculated mass profiles agree only when the formation of CO/sub 2/ in the vicinity of the particle is accounted for in the particle

energy balance. A simple model is used to account for CO/sub 2/ formation that results in overall rate parameters that agree well with the measured particle temperatures and carbon mass-loss profiles. The sphericity of the porous carbon used as the model char allows the calculation of the particle mass loss from measurements of the particle size and density, thereby verifying closure of the mass balances. The data set obtained from this work provides the necessary input for future experimental validation of theoretical models that describe processes occurring in the boundary layer of burning carbon particles.

14271 **The oxygen reaction order of SO/sub 2/ with CaO. Brief communication.** Simons, G.A.; Parker, T.E.; Morency, J.R. (Physical Sciences Inc., Andover, MA (US));. *Combustion and Flame;* **74**: No. 1, 107-110(Oct 1988).

In situ sulfur removal from coal-fired boilers via calcium-based sorbents has been studied extensively for the past decade. Either a calcium carbonate or a calcium hyroxide is injected directly onto the postflame combustion zone, decomposes into CaO, and reacts with SO/sub 2/ via the global reaction. While the global reaction suggests that the oxygen reaction order is 0.5, it is well known that chemical reactions do not occur via three-body collisions but rather occur in a series of two-body reactions. Hence, the rate limiting step could be the adsorption of SO/sub 2/, while the O/sub 2/ adsorption is relatively fast. The effective O/sub 2/ reaction order would then be very small. To test this hypothesis, a series of tests was conducted by Physical Sciences, Inc. (PSI) in its entrained flow reactor at a temperature of 1173°K and a pressure of 100 kPa. A well-characterized calcium hydroxide (Longview: 2.3 μm diameter, 75% porous, 15 m/sup 2//g internal surface area) was exposed to a gas mixture containing 3000 ppm SO/sub 2/ and 1-30% oxygen. The PSI entrained flow reactor is designed to simulate heterogeneous sorption and deposition processes, under well-characterized laminar flow conditions, in the postflame gases of combustion devices. It is presently being used to generate fundamental rate data on SO/sub 2/ sorption of calcium-based sorbents and for studies of coal mineral matter transformations and aerosol transport/deposition processes. A schematic of the reactor design is shown.

14272 **Modeling of agglomeration in a fluidized bed.** Rehmat, A.; Carty, R. (Institute of Gas Technology, Chicago, IL (US)); Huang, C. (Nalco Chemical, Naperville, IL (US)); Hariri, H.; Arastoopour, H. (Illinois Institute of Technology, Chicago, IL (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 176-187(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A fluidized bed containing a central jet was operated with low-temperature melting materials to obtain the rate of agglomeration as well as to measure the temperature distribution within the fluidized bed. The rate of agglomeration was obtained as a function of operating parameters such as temperature and velocity. The agglomeration rate defined, as the rate of change in the number of particles of a particular size, was determined from the particle population balance using the experimental data. The agglomeration model developed to predict the agglomeration rate constant based on the temperature distribution in the fluidized bed and the rate of entrainment of particles into the jet yielded values for the rate constants similar to the experimental values.

14273 **Flowfield simulations in industrial furnace configurations.** Gillis, P.A.; Smith, P.J. (Combustion Computations Lab., 75 CTB, Brigham Young Univ., Provo, UT (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 215-222(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A fundamental element of comprehensive pulverized-fuel combustion modelling is the description of the turbulent gaseous flow field within the furnace. As part of a program to develop a three-dimensional coal combustion code, a non-reacting gas flow dynamics model has been developed. This flow model, GAS3D, has been demonstrated in a variety of industrial configurations including corner-fired, cross-fired, and wall-fired furnace geometries. This paper discusses the components and capabilities of the model and presents comparisons between experimental data and model predictions for a wall-fired furnace. The emphasis of this paper is on evaluating model performance. Experimental data has been obtained from Consolidation Coal Company for a wall-fired furnace. This configuration has been simulated with GAS3D using three different turbulence models. A description of the flow patterns predicted within the furnace are given. Comparisons are made between the predictions and experimental data and between the different turbulence models.

14274 **Crosslinking reactions in coal pyrolysis.** Deshpande, G.V.; Solomon, P.R.; Serio, M.A. (Advanced Fuel Research, Inc., 87 Church Street, East Hartford, CT (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 310-321(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

During coal pyrolysis, the break up of the coal macromolecular network is controlled by the relative rates of bond breaking, crosslinking and mass transport. Crosslinking reactions are important because the ultimate tar yield and tar molecular weight distribution are dependent on the extent of these reactions. Crosslinking, as measured by solvent swelling experiments, is observed to be rank dependent, with lignites crosslinking at lower temperatures than bituminous coals. In a recent study of crosslinking, other investigators have observed that the crosslinking rate appeared to correlate with the evolution of CO/sub 2/. It appears that crosslinking may be related to the decomposition of carboxyl groups (whose concentration is rank dependent) to form CO/sub 2/. Recent research has also demonstrated that substantial reductions in the crosslinking can be achieved by ultra rapid heating. The high heating rate conditions for lignites produce melting and swelling of char, higher yields of soluble products, and product molecular weight distributions previously seen only for melting, easily soluble coals. This paper describes a study of crosslinking behavior in which chars of a number of coals have been pyrolyzed under a variety of temperature histories and analyzed at intermediate extents of pyrolysis for solvent swelling behavior, functional group compositions and gas evolution. The behavior is consistent with the hypothesis that low temperature crosslinking is related to the decomposition of carboxyl groups to form CO/sub 2/.

14275 **Physical and chemical transformations during pulverized coal combustion -- optical systems for measurements.** Ottesen, D.K.; Hardesty, D.R. (Sandia National Labs., Combustion Research Facility, Livermore, CA (US)); Radziemski, L.J. (Physics Dept. New Mexico State Univ., Las Cruces, NM (US)). *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 81-90(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

One of the most difficult problems in developing diagnostic methods for coal combustion research is that of determining the composition of entrained coal, char, and mineral matter particles in the combustion zone. The authors have employed two laser-based techniques for the simultaneous measurement of the size, velocity, and elemental composition of particles in combustion flows. Laser spark spectroscopy, also called laser induced breakdown spectroscopy (LIBS), is used to determine the elemental composition of coal particles. Sizing measurements are done using two-color laser light scattering. Laser spark spectroscopy is a variation of conventional emission spectroscopy which uses a focused pulsed laser beam to generate an optical breakdown, commonly called a laser spark or a laser induced plasma. The origin and uses of this technique are well summarized. Many of its properties are similar to those of conventional arc or spark plasmas as discussed in standard texts on spectrochemistry. As with conventional techniques, the laser spark allows simultaneous multi-element detection. An important advantage is the ability to obtain information in hostile environments, in situ, where electrodes cannot be introduced. Two principal applications for this technique are proposed. The first is the simultaneous measurement of size, velocity, and composition of single particles and is primarily an analytical research tool for coal

combustion studies. The second is the measurement of bulk properties before, during and after combustion by coaddition of hundreds or thousands of individual spectra. This can be envisioned as an on-line monitor in an operating combustor. The authors' experiments have elucidated the advantages and difficulties which will be encountered in these applications.

14276 **Fundamental modelling of pulverized coal and coal-water slurry combustion in a gas turbine combustor.** Chatwani, A.; Turan, A.; Hals, F. (Avco Research Lab., Inc., 2385 Revere Beach Parkway, Everett, MA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 2, 165-175(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

A large portion of world energy resources is in the form of low grade coal. There is need to utilize these resources in an efficient and environmentally clean way. The specific approach under development by us is direct combustion in a multistage slagging combustor, incorrporating control of NO/sub x/, SO/sub x/, and particulates. The toroidal vortex combustor is currently under development through a DOE contract to Westinghouse and subcontract to ARL. This subscale, coal-fired, 6MW combustor will be built and become operational in 1988. The coal fuel is mixed with preheated air, injected through a number of circumferentially-located jets oriented in the radius axis planes. The jets merge at the centerline, forming a vertically directed jet which curves around the combustor dome wall and gives rise to a toroidal shaped vortex. This vortex helps to push the particles radially outward, hit the walls through inertial separation and promote slagging. It also provides a high intensity flow mixing zone to enhance combustion product uniformity, and a primary mechanism for heat feed back to the incoming flow for flame stabilization. The paper describes the essential features of a coal combustion model which is incorporated into a three-dimensional, steady-state, two-phase, turbulent, reactive flow code. The code is a modified and advanced version of INTERN code originally developed at Imperial College which has gone through many stages of development and validation.

14277 **Development of advanced flue gas emissions control technologies at the Pittsburgh Energy Technology Center.** Joubert, J.I.; Drummond, C.J. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA (US));. pp v of Coal combustion: Science and technology of industrial and utility applications. Feng, J. New York, NY; Hemisphere Publishing (1988). (CONF-870934—).

From International symposium on coal combustion (ISCC); Beijing, China (7 Sep 1987).

Development of processes to control pollutant emissions resulting from combustion of coal has been under way at the U.S. Department of Energy's (DOE) Pittsburgh Energy Technology Center (PETC) since the early 1960's. The program at PETC supports and complements a substantial R and D effort conducted by the DOE office of Fossil Energy directed toward reducing emissions of sulfur dioxide, nitrogen oxides, and particulates from stationary combustion sources. This paper provides an overview of the PETC projects currently underway, which range from bench-scale fundamental studies to testing on the combustion products of coal at a scale equivalent to about one megawatt of electric power generation.

14278 **Coal-fueled gas turbines.** Byam, J.W.; Rekos, N. (Morgantown Energy Technology Center, Morgantown, WV (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

The program to develop coal-fuel based gas turbines was begun in the early 1980's at the Morgantown Energy Technology Center and has had three main elements. These included basic data studies, systems and economic studies, and component/system development. The basic data element was designed to address needed information on the effects of coal and coal type on the combustion contaminants relating to turbine components. Basic combustion phenomena tests were carried out at the Morgantown Energy Technology Center and by various industrial organizations to accomplish this goal. The systems and economic studies were undertaken by gas turbine manufacturers to provide program assessments and indicate the direction of R and D efforts required to develop a commercial system. The component development portion of the program began in 1986, with the award of component development and integrated system test contracts to major U.S. gas turbine manufacturers. Ultimately, the success of the program will be measured by the willingness of the various industrial concerns to take the results of the proof-of-concept R & D efforts currently underway and develop commercial systems. Industrial interest to date has been excellent, as shown by the willingness of private companies to provide considerable cost sharing for each element of the program.

14279 **Coal-fueled diesels.** Carpenter, L.K.; Byam, J.W. Jr. (US Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

The U.S. Department of Energy (DOE) initiated exploratory efforts during the late 1970's to reassess the use of coal fuels in diesel engines. Advancements in coal fuel processing and in engine materials of construction had evolved to a point where it appeared to be feasible to burn beneficiated, micronized, solid-coal particles in diesel engines. In the early 1980's, the Office of Fossil Energy sponsored small-scale fuel and engine combustion tests, tests which proved that it was technically feasible to burn coal fuels in a diesel engine. Currently, the Office of Fossil Energy, through its Morgantown Energy Technology Center (METC), is continuing to conduct a program for the development of advanced coal-fueled diesel engines for use in transportation, industrial, cogeneration, and small utility markets. This paper summarizes the progress to date and the challenges remaining before an old dream of using coal fuels in diesel engine power systems will become a reality.

14280 **Pore structure and combustion kinetics. Interpretation of single particle temperature-time traces.** Sahu, R.; Northrop, P.S.; Flagan, R.C.; Gavalas, G.R. New York, NY; American Institute of Chemical Engineers (1987). 27p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 17D.

Single particle combustion experiments were carried out with 50 - 100 μm char particles derived from one lignite and one HVA bituminous coal. Reactor wall temperatures in the range 1050 K to 1450 K and oxygen partial pressures of 0.21 and 0.5 were used. The complete temperature-time histories of individual burning particles were measured using non-intrusive two-color optical pyrometry techniques. Apparent combustion rate parameters of the chars were then inferred using a model of single particle combustion and a novel statistical estimation technique.

14281 **Polynuclear aromatic compounds in fluidized bed combustion of bituminous coal, subbituminous coal, and oil shale.** Chiu, K.S.; Walsh, P.M.; Beer, J.M. (Dept. of Chemistry, Massachusetts Institute of Technology, Cambridge, MA (US)). pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

A substantial research effort has been devoted to studies of the potential environmental impact of FBC. This work includes a number of investigations of the polynuclear aromatic compound (PAC) content and mutagenic activity of the effluents from experimental and industrial FBC. The initial suspicion that, because the temperature in FBC in low, PAC emissions might be more difficult to control in FBC than in conventional combustion, has not been substantiated by these measurements. It has been observed, however, that PAC concentrations in the effluents from various types of fossil fuel combustors, including FBC, depend upon the combustor

configuration and operating conditions. The goal of the present work is to elucidate the effects of fuel type, bed material, temperature, fuel/air ratio, residence time, and fuel feed point on the concentrations of PAC in the effluents from atmospheric pressure fluidized bed combustion (AFBC).

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 14125, 14143, 14221, 14222, 14254, 14256, 14298, 14320, 14873, 14874, 14875

14282 (CONF-8809248—1) Potential role for Colombia and Venezuela in Pacific Rim coal trade. Dials, G.E.; Szpunar, C.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89004274/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

In this paper we are going to focus on the role that two of the new entrants into the international coal market, Colombia and Venezuela, could play in a segment of the Pacific Rim Market. We will analyze their potential market capabilities and actions in terms of meeting the international coal trade demands of Japan, Hong Kong, South Korea, and Taiwan. 13 refs., 4 figs., 14 tabs.

14283 (DOE/FE/60457—T2) The Coal Logistics System: Documentation and user's guide. (Sheladia Associates, Inc., Gaithersburg, MD (USA)). Oct 1988. Contract AC01-84FE60457. 96p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005856/JAW.

The Coal Logistics System (CLS) has the capability to track coal from a US mine or mining area to a foreign consumer's receiving dock. The system contains substantial quantities of information about the types of coal available in different US coalfields, present and potential inland transportation routes to tidewater piers, and shipping routes to and port capabilities in the five importing nations now included. It is designed to facilitate comparisons of coal quality and price at several stages of the export process, including delivered prices at a wide range of destinations from Trieste to Vado Ligure in Italy, and from Muroran in northern Japan, to Sri Racha, near Bangkok, along the Asian Pacific Rim. The CLS can also be used to examine coal quality within or between any of 18 US coalfields, inciuding three in Alaska, or compare alternative routes and associated service prices between coal producing regions and ports-of-exit. It may be used to explore the possibilities of different ship sizes, marine routes, and foreign receiving terminals for coal exports. The CLS interacts with users through a series of menus that provide the user with simple choices. 30 figs.

14284 (DOE/PC/79883—T1) Maximizing the existing potential of new foreign markets for anthracite. Ziolkowski, L.W.; Ahn, Y.K.; Hong, S.P. (Economic Development Council of Northeastern Pennsylvania, Pittston (USA); Anthracite and Community Development Inst., Pittston, PA (USA)). Sep 1988. Contract FG22-87PC79883. 332p. NTIS, PC A15/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006086/JAW.

The major purposes of this report were to: (1) conduct an in-depth survey of both the technical and marketing problems in the United States Anthracite Industry (predominately in Northeastern Pennsylvania); and (2) make recommendations in areas of technical R and D needs that will enhance the United States export of anthracite to foreign markets (especially Korea). The report identifies various anthracite culm drying and other coal utilization concepts; recommends several anthracite utilization configurations which appear to be the most suitable to the Korean market and a sensitivity analysis on these configurations; and identifies several solutions to resolve some of the problems which were identified relative to: (a) reducing the price of exporting anthracite; (b) the producers quality control activities which relate to meeting the Korean specifications and generally improving the understanding on the contract terms that relate to the encouragement of long term commitments of anthracite by Korea. 33 refs., 23 figs., 33 tabs.

14285 (DOE/PC/79883—T1-Exec.Summ.) Maximizing the existing potential of new foreign markets for anthracite: Executive summary. Ziolkowski, L.W.; Ahn, Y.K.; Hong, S.P. (Economic Development Council of Northeastern Pennsylvania, Pittston (USA)). Sep 1988. Contract FG22-87PC79883. 99p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006085/JAW.

The major purposes of this report were to: (1) conduct an in-depth survey of both the technical and marketing problems in the United States Anthracite Industry (predominately in Northeastern Pennsylvania); and (2) make recommendations in areas of technical R and D needs that will enhance the United States export of anthracite to foreign markets (especially Korea). Furthermore, the report identifies various anthracite culm drying and other coal utilization concepts; recommends several anthracite utilization configurations which appear to be the most suitable to the Korean market and a sensitivity analysis on these configurations; and identifies several solutions to resolve some of the problems which were identified relative to: (a) reducing the price of exporting anthracite; (b) the producers quality control activities which relate to meeting the Korean specifications and generally improving the understanding on the contract terms that relate to the encouragement of long term commitments of anthracite by Korea. 5 figs., 11 tabs.

14286 (EMR/E—1976, pp 7-25) US coal supply and Canadian coal demand. Sall, G.W. (Federal Energy Administration, Washington). 1976. CANMET/TIC, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

An examination is made of the present and future state of coal supplies in the USA and role of these supplies in satisfying Canadian coal demand. The US coal supply is characterized by a large percentage of the demand being furnished by a small number of major producers, supplying coal under stable long-term contracts, and a smaller percentage of the demand being supplied by a large number of small producers, who generally meet the less stable demands of the spot market. Coal supply tends to be a function of demand in the sense that new mines are opened unless assurance, normally in the form of a long-term contract, is provided that the coal can be sold. Three independent forecasts of coal demand are presented, which predict an increase of 350-450 million tons by 1985. Constraints on meeting this demand, including financial, manpower requirements, rail capacity, and production equipment availability are discussed, and no major obstacles are foreseen that could impede an increase in coal production to meet such a demand. Exports to Canada are not seen to be in jeopardy. Expanded Canadian production is not expected to decrease coal imports from the USA because transport costs are a major factor in coal costs, i.e. the large coal consumers in central Canada will find it cheaper to buy coal from nearby US sources than from western Canada. Congressional action to curb coal exports is not seen as a likely possibility. 10 figs., 5 tabs.

14287 Economic factors affecting the rate of development of coalbed methane resources. Flaim, S.J.; Hemphill, R.C.; Cohn, J.E. (Argonne National Lab., Argonne, IL (US));. pp v of Proceedings of the 1987 coalbed methane symposium. Tuscaloosa, AL; Eastern Region Coalbed Methane Resource Center (1988). (CONF-8711110—).

From Coalbed methane symposium; Tuscaloosa, AL, USA (16 Nov 1987).

The analysis contains as comparison of recent price forecasts for natural gas and a discussion of the discrepancies among the commercial services (Data Resources and others) and the Department of Energy Policy Plan. The assumptions underlying projected growth in energy sectors are explained. The analysis also includes an examination of historical exploration and development costs for crude and conventional methane resources based on footage and discoveries data from 1947 to 1984. Costs per crude equivalent barrel (COE-BBL) are computed for conventional methane resources and compared with costs similarly computed for some representative coalbed methane wells. Demand projections show nearly level growth for domestic natural gas discoveries per crude

equivalent barrel. Coalbed methane appears to be substantially less costly than exploring for conventional resources. With reasonable access to existing pipelines, coalbed methane resources may be less costly than drilling development locations for conventional methane.

0160 Health And Safety

REFER ALSO TO CITATION(S) 14281, 14893, 15967

14288 **(DOE/OR/21446—T1) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 100p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006270/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14289 **(DOE/OR/21446—T1-App.A) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix A, Subchronic studies of first-stage solid products.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 226p. NTIS, PC A11 - OSTI. Order Number DE89006271/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14290 **(DOE/OR/21446—T1-App.B) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix B, Subchronic studies of second-stage solid products (TSL solids).** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 256p. NTIS, PC A12 - OSTI. Order Number DE89006272/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14291 **(DOE/OR/21446—T1-App.C) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix C, Lifetime inhalation carcinogenicity studies of first-stage solid product (SRC solids).** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 335p. NTIS, PC A15 - OSTI. Order Number DE89006273/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14292 **(DOE/OR/21446—T1-App.D) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix D, First-stage middle distillate subchronic studies.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 154p. NTIS, PC A08 - OSTI. Order Number DE89006274/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14293 **(DOE/OR/21446—T1-App.E) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix E, Second-stage middle distillate subchronic studies.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 148p. NTIS, PC A07 - OSTI. Order Number DE89006275/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers'

health safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14294 **(DOE/OR/21446—T1-App.F) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix F, First-stage middle distillate dermal carcinogenesis studies.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 511p. NTIS, PC A22 - OSTI. Order Number DE89006276/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic,, carcinogenic, and teratogenic potential---of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14295 **(DOE/OR/21446—T1-App.G) Genetic and animal toxicity testing of SRC-I products, intermediates, and waste materials: Final report: Appendix G, Second-stage middle distillate dermal carcinogenesis studies.** Drozdowicz, B.Z.; Kelly, C.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Nov 1987. Contract AC05-84OR21446. 506p. NTIS, PC A22 - OSTI. Order Number DE89006277/JAW.

We have completed an extensive program to investigate the toxicity---including mutagenic, carcinogenic, and teratogenic potential—of SRC-I (Solvent Refined Coal-I) products, along with selected intermediates and waste materials, as represented by the SRC-I Design Baseline. The original primary objective of the toxicology program was to produce data that could be used for four main purposes: to support design of programs to ensure workers' health and safety; to help estimate environmental impacts of SRC-I technology; to support the Toxic Substances Control Act (TSCA) premanufacturing notification process for SRC-I technology; and to promote public understanding and acceptance of the potential health effects of the emerging synfuels industry. The toxicology program consists of five main elements: (1) Genetic Toxicity Evaluations; (2) Acute Animal Toxicity Evaluations; (3) Subchronic Animal Toxicity Evaluations; (4) Chronic (life-span) Animal Carcinogenicity Evaluation; (5) Quality Control/Quality Assurance (QC/QA) Monitoring and Evaluation.

14296 **Factors that influence the effective placement of coalbed methane drainage wells for removal of gob gas above longwall panels.** Layne, A.W.; Siriwardane, H.J.; Byrer, C.W. (U.S. Dept. of Energy, Morgantown Energy Technology Center, MV (US));. pp v of Proceedings of the 1987 coalbed methane symposium. Tuscaloosa, AL; Eastern Region Coalbed Methane Resource Center (1988). (CONF-8711110—).

From Coalbed methane symposium; Tuscaloosa, AL, USA (16 Nov 1987).

This paper focuses on the factors that influence the effective placement of vertical wells for removal of gob gas. The placement of wells into the gob area is currently based on a trial-and-error method. The productivity of these wells depends on their location in the gob area and the spacing between wells. A more accurate prediction of the geometry of the gob area will greatly benefit the coal operator in effectively placing gob wells. In this paper, the finite element method was used to determine the size and shape of the gob area, and a two-phase reservoir model was used to compute increased production rates from methane wells in the gob. Production data from actual gob wells at a longwall panel in the Appalachian Basin were history-matched to characterize flow mechanisms and reservoir properties, such as permeability. These properties were then evaluated in parametric studies to determine the influence of well location on gas production. Results indicate that cumulative gob-gas production can be increased by placing wells far apart. However, this configuration may increase the methane concentration at the mine face. The model appears to make reasonable predictions of the size of the gob area and can also predict the size of the gob area for more complex geologic conditions. The study considered the influence of an advancing mine face on gas production. Thus, the methodology presented in this paper is applicable to the design of gob gas wells in dynamic reservoirs.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 14343

14297 **(DOE/FE—0112) Public meetings for views and comments on the conduct of the 1989 clean coal technology: Background information.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). 1989. 257p. NTIS, PC A12/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005511/JAW.

Public meetings were convened by the Department of Energy (DOE) in order to obtain views, comments, and recommendations with regard to the Innovative Clean Coal Technology (ICCT) solicitation. Brief descriptions are provided of the background to the ICCT solicitation and the public meetings, and how the meetings were conducted. Subsequent chapters of this report present the discussions that ensued at each of the meetings, and the views, recommendations, and concerns that were expressed by attendees. The report includes a compilation of the written comments that were received, information on budget needs of R and D programs, and DOE energy policy excerpt. (CBS)

14298 (EMR/E—1976, pp 89-90) **Transformation of Canada's coal reserves in the ground to coal supply at the point of use.** Fulton, R.B. (McIntyre Mines Ltd.). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $034 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

This paper describes the steps involved in bringing a deposit of bituminous metallurgical coal on the Rocky Mountains of Alberta or British Columbia into production. These steps are described in the context of current technology, marketing practices, and government policy. Exploration and evaluation of a coal property are made difficult by the characteristics of deposits in that region, including contorted geologic structure and variations in coking properties. Next come various stages of mine planning and ensuring means of transporting the coal to the user or export point. In marketing the coal, the region is well situated to supply Japan; current sales to that country are some 10 million long tons per year. Contracts with the Japanese were intially long-term but have changed to more market-oriented types. Marketing coal to the Great Lakes area is constrained by high freight rates. In financing the coal development, increasing costs have meant an increased customer involvement in the mine investment. Final steps involve mine construction and start-up. Problems mentioned in this regard include long construction times and the scarcity of qualified mine personnel. The total time for transforming a coal deposit into a working mine can take the better part of a decade and cost hundreds of millions of dollars. In spite of this, a sizeable number of new coal developments in Western Canada is expected.

02 PETROLEUM

REFER ALSO TO CITATION(S) 16907

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 14305, 14314, 14329, 16862, 16901, 16906

14299 **(CMO—8308) Resource management plan for Lancaster Sound Region hydrocarbon development.** (Consolidex Magnorth Oakwood, Calgary, Alberta (Canada)). 1983. 433p. (CE—02332). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this plan is to provide information about a proposal to drill a single test well in Lancaster Sound, Northwest Territories, within the context of a long-term projection of activities and the potential social and environmental effects which would follow an oil discovery. This report details the short-term component of the plan, i.e. drilling the well, and outlines the technical operations, social conditions, and environmental conditions and protection procedures. In an examination of the long-term consequences, the report includes the relationship of hydrocarbon development to Canadian industrial growth, energy self-sufficiency, and government policies. The anticipated economic viability of the prospect and the pace of development; the capability to meet future development, production and transportation requirements; and the ability to ensure protection of the biological environment are also addressed. A comprehensive statement of the exploration consortium's policy is given, and information is presented outlining the ways and means through which the prospective social and environmental consequences of hydrocarbon related activities will be manageable and beneficial in the long term, should oil be discovered. 325 refs., 52 figs., 12 tabs.

14300 (IT—1986, pp 5) **Integration of exploration software tools.** Mostert, J.A. (Intergraph Systems Ltd.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

This paper examines the integration of data, analytical processes, and users into an interactive software environment in order to increase the productivity of petroleum exploration efforts. Integration consists of rationalizing the sources of useful data and specialized application software into a consistent user interface. Development of an integrated exploration system draws heavily on the concepts and techniques of a geographic information system (GIS), which allows users to access and invoke analytical processes against data and posts results to a common geopositioned model. Development of a GIS framework for such an integrated system uses a continuous base map stored in separate files, with information layering, linking of graphic elements to a non-graphic database, cross-referencing of multiple data sources, and accessing of data sets by a variety of analytical processes. This technology has found acceptance in the energy sector and further developments have fostered functional stand-alone tools for the petrophysicist, geophysicist, and geologist.

14301 **Computation and interpretation of capillary pressure from a centrifuge.** Skuse, B.; Ramey, H.J. Jr. (Stanford Univ. (US)); Firoozabadi, A. (Norsk Hydro a.s. (NO));. pp v of Proceedings of the 1988 SPE 63rd annual technical conference and exhibition. Richardson, TX; Society of Petroleum Engineers (1988). (CONF-881012—).

From 63. Society of Petroleum Engineers (SPE) annual technical conference and exhibition: reservoir engineering; Houston, TX, USA (2 Oct 1988).

Centrifuge capillary pressure measurements are usually conducted at atmospheric air pressure. In such measurements, any capillary pressure exceeding atmospheric pressure requires a negative pressure in the wetting phase. Experiments were conducted to examine the effect of air pressure on air-brine capillary pressure. First, drainage capillary pressure curves were determined for six low permeability core samples under atmospheric pressure. Then, drainage capillary pressure curves were determined at an elevated air pressure of 112 psia (0.11 MPa) for the same samples. The two capillary pressure curves for each of the core samples are generally in close agreement. Both the measurements reported in this paper and the data from literature indicate stable behavior for the wetting phase under negative pressure conditions. The measurements of this study indicate that both positive and negative pressures of the wetting phase yield the same capillary pressure-saturation relationships. The conditions of mechanical and chemical equilibrium of curved surfaces presented in the paper provide an interpretation of negative pressure.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 14330, 14341, 14350

14302 **(DGMK—343) Interactions of drilling muds and rocks. Final report.** Marx, C.; Grossmann, U.; Hoebel-Bittermann, C.; Stoll-Steffan, M.L. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1987. 156p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

The rock permeability near the wellbore can be affected by drilling mud interactions. Preventive efforts are therefore essential to minimize formation damage. A laboratory device was developed to evaluate the interactions of drilling muds with rocks. This device consists of a circulation apparatus to simulate the interactions during mud infiltration into rocks. For practical purposes the experiments are to be conducted under simulated wellbore conditions using plugs of rock materials from pay zones. The depth of infiltration as well as the intensity of interactions are investigated by petrophysical messurements. Main evaluation criteria are the permeability ratio K/sub r//K/sub o/ (damage ratio, DR) and the sectional permeability ratio K/sub rn//K/sub o/ (sectional demage ratio, SDR). Additional mineralogical and chemical investigations are conducted to characterize the damage mechanisms. Character and distribution of permeability reduction are analized by thin polish microscopy, REM and X-ray defraction. The results show, that the penetration depth of mud particles is small. Polymers, however, are able to penetrate very much deeper into the rocks and to reduce permeability. As final conclusion there is to expect only a small effect of formation damage by the drilling muds investigated. (orig.) With 78 figs.

14303 **(DOE/BC—89/3/SP) Handbook for personal computer version of Boast II: A three-dimensional, three phase black oil applied simulation tool.** Stapp, L.G.; Allison, E.C. (USDOE Bartlesville Project Office, OK). Jan 1989. 79p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000725/JAW.

Computer programs have become an important part of modern petroleum engineering. Black oil simulators, in particular, are used routinely for performing evaluation and design work. Until the 1982 release of BOAST: A Three-Dimensional, Three-Phase Black Oil Applied Simulation Tool, a black oil simulator was available usually only for a substantial fee. Since its release by the Department of Energy, BOAST has gained popularity because of its uncomplicated, easy-to-use features. However, problems occur when BOAST is used for field-scale conditions. BOAST II, released in 1987, was designed to overcome the limitations of the original BOAST. Features were added which would improve the versatility of the program. The amount of code in BOAST II is approximately three times that of the original BOAST. This handbook describes a version of BOAST II that has been developed for use on the personal computer. This version combines most of the options available on the original BOAST II with the size necessary to fit on a personal computer. This makes it possible for users who do not have access to a mainframe computer to use BOAST II. This manual is intended to be only a guideline for the use of the PC

version of BOAST II. Detailed discussions on theory, solution methods, program output, and other important topics are found in the BOAST II manual. 5 refs.

14304 **(DOE/BC/10843—10) Investigation of the application of gelled polymer systems for permeability modification in pertroleum reservoirs: Second annual report, October 1986--September 1987.** Willhite, G.P.; Green, D.W.; Thiele, J.L.; Young, Teng-Shau; Mertes, K.B. (Kansas Univ., Lawrence (USA)). Nov 1988. Contract AC19-85BC10843. 183p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE88001250/JAW.

Research is reported for the second year of an integrated research program to improve the performance and predictability of in situ gelation processes designed to alter the permeability of porous rocks. The research is focused on physical and chemical description of gelling systems, experimental studies of in situ gelation, and development of correlations and/or mathematical models for the design of in situ gelling processes. Physical characterization studies resulted in determination of long-term swelling and syneresis properties of Cr(III)/xanthan gum and Cr(III)-PAAM (polyacrylamide) gels and measurement of molecular weight distributions of PAAM and hydrolyzed PAAM in Berea core effluents. The gelation behavior of emulsion polyacrylamides was examined. An empirical rate expression for the kinetics of the reaction between Cr(III) and an unhydrolyzed polyacrylamide was developed. Characteristics of several chrome/polymer gelling systems were studied under oscillatory shear and superposition of steady and oscillatory shear. In our studies of in situ gelation, an experimental program to determine the flow characteristics of biopolymer in unconsolidated sandpacks was completed. Empirical correlations were developed between polymer concentration and the power law parameters required to estimate polymer flow characteristics. Research was completed on the in situ gelation of a thiourea/Cr(VI)/cationic polyacrylamide system in unconsolidated sandpacks. Preliminary results were obtained on the long-term stability of Cr(III)/xanthan gels under continued water injection. Research on the aluminum citrate process of permeability modification was focused on adsorption and desorption studies of aluminum on silica sand and crushed Berea sandstone core material.

14305 **(DOE/BC/10849—10) Systematic procedure for reservoir characterization: Annual report, October 1, 1986--September 30, 1987.** Lake, L.W.; Kocurek, G.A.; Miller, M.A. (Texas Univ., Austin (USA)). Nov 1988. Contract AC19-85BC10849. 253p. NTIS, PC A12/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000707/JAW.

The general objective of this work is to develop procedures to enhance the accuracy and reliability of numerical simulation of oil recovery processes. The approach is to encapsulate geological observations into a numerical/statistical format, convert these into a random field of properties and then to simulate fluid flow through the field. The procedure should retain the geologic insight of more traditional methods while incorporating more spatial variability and, we believe, more realism into simulation. In this report we deal with several topics which lead up to the general goal. We give results on hydrodynamic simulations of viscous fingering and on the theoretical calibration of a field minipermeameter, discuss applications of this device to two outcrops in the Page sandstone and a San Andres dolomite, give results on theoretical analysis of the bias and precision of autocorrelation measures and, finally, introduce fluid flow simulations in the Page sandstone outcrop as a means of validating reservoir characterization procedures. 33 refs., 82 figs., 3 tabs.

14306 **(DOE/BC/14204—1) Cyclic CO_2 injection for light oil recovery: Performance of a cost shared field test in Louisiana: First quarterly report, 21 November 1988--21 February 1989.** Monger, T.G. (Louisiana State Univ., Baton Rouge (USA). Dept. of Petroleum Engineering). [1989]. Contract FG19-89BC14204. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006978/JAW.

Progress is briefly described on CO_2 oil well injection. Laboratory corefloods, field tests and numerical simulation results are discussed. (CBS)

14307 **(NIPER—368) Effects of 1-butanol on the micellization of dodecyltrimethylammonium bromide at elevated temperatures.** Noll, L.A.; Lam, A.C. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1989. Contract FC22-83FE60149. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000723/JAW.

Enthalpies of dilution of 1-butanol (BuOH) have been measured from 323 to 448 K (50{degree} to 175{degree}C) and the enthalpies of dilution of dodecyltrimethylammonium bromide (DDTAB) in 0.2 and 0.6 m (1.5 and 4.5% by weight) aqueous BuOH were also measured at 373 and at 448 K. The relative partial molar enthalpies of BuOH which are endothermic at lower temperatures approach zero at 400 K, where the sign reverses. This trend is interpreted as showing that there is less difference between BuOH and water at elevated temperatures. The presence of this alcohol causes the critical micelle concentration (CMC) of DDTAB to be lowered at 373 K, but has no effect on it at 448 K. The alcohol has less effect on the CMC and the sharpness of micellization than does an equal molal concentration of electrolyte. 13 refs., 7 figs., 16 tabs.

14308 **(PRI—1981-7) Provost Upper Mannville B steam injection project.** Hayashitani, M.; Davis, W. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). 1981. 122p. (CE—02104). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A field aplication study was conducted of a steam injection oil recovery process at an Alberta oil pool selected as being the prime candidate for such a recovery scheme. Previous analyses of reservoir data provided initial estimates of physical and petrophysical properties of the reservoir rock and fluids. The reliability of these values was studied by the production history matching of the steam injection test well. History matching was conducted using a computerized steamflood model, and the objectives were to recognize the problems and limitations of using a numerical model for reservoir engineering studies of steam injection processes, and to evaluate uncertainties in values of basic properties assigned to particular sections of the pool. For the purpose of this study, the field test was divided into 4 periods, covering primary recovery, injection and soak, short term production, and long term production. The injection period was studied first, and 10 computer runs were made in an effort to match the injection rate and injection pressure. The primary recovery period was then studied and 5 computer runs were performed; history matching results suggested a higher reservoir permeability than was iniially estimated. Matching of the steam injection period was not successful because a rapid decline of the injection pressure with time could not be totally explained. A study of the economics of the operation showed a positive prospect for field application of the steam process. 22 refs., 10 figs., 14 tabs.

14309 (PRI—1981-7B, pp 27) **History matching of steam project No. 2 in Provost Upper Mannville B pool.** Hayashitani, M.; Davis, W. 1981. Petroleum Recovery Inst., Calgary, Alberta (Canada). (CE—02104).

In Provost Upper Mannville B steam injection project.

The performance of a pilot steam stimulation test at an Alberta well was matched by numerical simulator. This second test at the field was designed to test a type of well completion for better sand control. The well penetrated only the top 11 m of the McLaren sand and the uncertainties in the total pay thickness was one of the major problems in the matching study. The well produced mainly water indicating the presence of bottom water zone at this well location. Two reservoir models were developed to account for a large number of shale breaks and/or tight sand zones present within the pay zone which provide restrictions to the vertical flow of fluids. A value of 0.005 for the vertical to horizontal permeability ratio was used in one model and zero transmissibility was incorporated between two adjacent layers for limited radial extent in the other. Both models two adjacent layers for limited radial extent in the other. Both models produced reasonable history match; however, the former model is preferred at this time mainly because of its simplicity. Besides the uncertainties in reservoir description due to incomplete penetration of the pay zone, lack of data needed to arrive at a unique history match was recognized in

this study. Therefore observation well(s) to monitor pressures and temperatures in the reservoir are recommended. The study confirmed the validity of basic reservoir property data used in a previous study including the permeability-porosity relationships, live oil viscosity and the rock compressibility. 8 figs., 4 tabs.

14310 (PRI—1981-7B, pp 27) **Steam injection simulations for the Provost Upper Mannville B pool.** Hayashitani, M.; Davis, W. 1981. Petroleum Recovery Inst., Calgary, Alberta (Canada). (CE—02104).

In Provost Upper Mannville B steam injection project.

An optimization study for steam flooding of an oil pool in Alberta was conducted using the INTERCOMP steamflood numerical simulator. The simulator was used in the non-compositional mode with a three-dimensional grid system for a 1/12 of an inverted seven-spot pattern. Five example areas which contained more than 75% of the total remaining oil in place were selected from 12 characteristic sections of the reservoir. For each case studied, the production well underwent a one-cycle steam stimulation operation. The steamflood proper started as the producer was put on production. The production rate was controlled by bottom hole pressure and a maximum fluid production rate. An optimization procedure was applied to maximize an objective function, called FCDNO (Final Cumulative Discounted Net Oil) subject to the following operation variables: the well perforation intervals, injection rate, and pattern size. Well costs were included. For all five cases studied, the steam injection oil recovery process could be applied profitably. The level of profitability of each case appeared to be related to the thickness of the oil-bearing sands even when bottom water was present. It is recommended that a pilot test site be chosen in a portion of the reservoir where there is expected to be good reservoir homogeneity and pay thickness. 11 refs., 5 figs., 7 tabs.

14311 **(PRI—7910) Effectiveness of carbon dioxide displacement under miscible and immiscible conditions.** Lee, I.J. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). 1979. 47p. (CE—02239).

Carbon dioxide flooding under miscible conditions is recognized as an effective enhanced oil recovery process. Immiscible displacement with carbon dioxide is also considered to have potential for improving recoveries in situations where miscibility cannot be achieved. This report presents the results of CO/sub 2/ displacement measurements at both miscible and immiscible conditions. Parallel studies of phase behaviour and viscosity properties were carried out to support interpretations of the flow tests. Carbon dioxide displacements using a synthetic oil with and without methane showed that the presence of methane did not significantly influence the minimum miscibility pressure, as defined by the recovery in a slim-tube test. Some comparisons were also made of immiscible oil displacement by N/sub 2/, CH/sub 4/ and CO/sub 2/ to investigate the differing effects of swelling factor and viscosity ratio. The existing correlations for predicting CO/sub 2/ minimum miscibility pressures are reviewed and two additional empirical correlations have been proposed. One of the new correlations is based on the oil extraction capability of liquid CO/sub 2/ and the other is derived from an analysis of available literature data. 18 refs., 20 figs., 12 tabs.

14312 **(PRI—RR-39) Polymer solution degradation and the meaning of screen factor. Research report.** Batycky, J.P.; Masata, V.K. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). 1978. Vp. (CE—02241). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Degradation tests on aqueous solutions of polyacrylamide and hydroxyethyl cellulose polymers used in displacement fluids have been performed in order to measure the dependence of screen factor and solution viscosity on molecular weight. Molecular weight was interpreted by measuring intrinsic viscosity. It was found that solution viscosity decreased linearly with intrinsic viscosity for both polymer types. However, in the case of the polyacrylamides it was determined that screen factor degradation occurred in two regimes. At low levels of degradation, and hence high values of screen factor, minor decreases in molecular weight produced substantial lowering of screen factor. This behaviour supports the concept that intermolecular forces are predominant in the development of solution properties. It was therefore concluded for undegraded polyacrylamide that molecular weight is not the only basis of screen factor. At high levels of degradation, i.e., low sceeen factor, there is displayed a screen factor-intrinsic viscosity relationship which is similar to that of nonionic hydroxyethyl cellulose polymer. In this region, the screen factor levels show weak intermolecular interaction when compared with those of undegraded polyacrylamide. The degradation in screen factor is characterized by molecular scission and therefore shows strong molecular weight dependence with little further change in intermolecular force levels. Continuous shearing tests at reservoir shear rates have shown that deteriorations in screen factor, and hence reductions in the resistance factors which would be developed during flow in porous media, occur over long periods of time. It is therefore necessary to include long term testing, within porous media if possible, to characterize polymer behavior for flood design. 24 refs., 8 figs., 7 tabs.

14313 **(PRI—RR-41) Dependence of residual oil mobilization on wetting and roughness.** Batychy, J.P. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). 1979. 65p. (CE—02240). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Experiments were conducted using plastic spheres to simulate reservoir rock being subjected to mobilization of residual oil. The experiments were performed to quantitatively relate receding and advancing contact angles of the entrapped phase to the surface roughness. A mobilization model suggests that the necessary pressure gradients for mobilization are proportional to the difference between the reciprocal radii of curvature existing at the leading and trailing edges of a ganglion. Using the experimentally derived contact angle behavior, it was determined that while mild increases in pressure drop are necessary for mobilization as roughness is increased, the pressure drop was found to be always lower at a contact angle of 90 degrees than it was at zero degrees. However, the sphere pack experiments show that increases in contact angle result in increases in forces required to mobilize the residual oil. The above model appears to be applicable to systems in which the oil phase is strongly non-wetting or when the ganglion volume is so small that its rear surface does not contact the solid. In other cases, additional work must be performed to reduce the radius of curvature and cause a jump from the solid surface, as the experiments indicated. It was also found that roughened surface systems required lower mobilization force levels. It is also possible that during attempted mobilization, ganglia can break into smaller units, which are more difficult to mobilize; in a reservoir, this tendency could be reduced by using suitable additives to ensure water-wet conditions, which would both lower the mobilization force and reduce the tendency to create smaller residual globules. 30 refs., 13 figs., 9 tabs.

14314 **Analysis of CO/sub 2/ pressure transient data with two-and three-region analytical radial composite models.** Tang, R.W. (Chevron Oil Field Research Co. (US)); Ambastha, A.K. (Stanford Univ., Stanford, CA (US));. pp v of Proceedings of the 1988 SPE 63rd annual technical conference and exhibition. Richardson, TX; Society of Petroleum Engineers (1988). (CONF-881012—).

From 63. Society of Petroleum Engineers (SPE) annual technical conference and exhibition: reservoir engineering; Houston, TX, USA (2 Oct 1988).

The results from this study show that pressure transients influenced by the intersection of fluid flow and phase behavior can behave as a three region composite reservoir. The intermediate region in this study was a high compressibility region that resulted from CO/sub 2/-oil interaction. Although two-region models have been applied successfully in thermal EOR and geothermal projects, a two-region model is unable to explain psuedo-steady state behavior observed in some miscible gas injection falloff tests. Three-region modeling combined with compositional simulation may be appropriate if pseudo-steady state response is observed, especially when mobility ratio is not large enough to manifest in a psuedo-steady state behavior based on two-region models. A series of injection falloff tests were performed at a West Texas reservoir in an effort to establish injectivities and in situ flow parameters during

water and CO/sub 2/ injection. The results from the field test in combination with laboratory tests will provide part of the engineering basis for design and operation of future CO/sub 2/ EOR projects at a West Texas reservoir. Falloff data and interpretation are presented along with experimental and compositional simulation results. In situ parameters such as mobility ratio, swept volume, and average CO/sub 2/ saturation in the swept region were estimated from the falloff data. The falloff analyses results are in good agreement with laboratory measurements and theoretical predictions. Therefore, this type of injection testing may be desirable in most EOR projects.

14315 **Development of a swaged pile/sleeve connection system for application on a North Sea jacket.** Clarke, J.; Peel, J.W.; Lowes, J.M. (BP Intl. Ltd. (GB));. pp v of Proceedings of the twentieth annual offshore technology conference. Volume 3. Richardson, TX; Offshore Technology Conference (1988). (CONF-880597—).

From Offshore technology conference; Houston, TX, USA (2 May 1988).

The hydraulically swaged pile/sleeve connection system has gained general acceptance in the installation of sub-sea structures. Generally piling for such structures is of small diameter and loading levels are low. Nevertheless the simplicity and speed of operation of the swaged system has made it the preferred option and has created a significant interest in its potential for larger jacket structures. In early 1986 BP expressed an interest in using the technique on one of their Southern North Sea Gas Platforms. Since the loading requirements and scale of operation for a North Sea Jacket Installation were substantially greater than the current state of the technology, this led to BP Exploration entering into a development programme together with the UK Dept of Energy and BUE Hydra-lok. A programme was defined, with the aid of the relevant authorities which, when successfully completed would enable the system to be used as a large diameter pile/sleeve connection. The paper discusses the results of analysis and testing undertaken during the program. The program included cyclic testing, full scale 72" connection load testing, bending tests and load testing on multiple groove geometries. As a consequence of this testing and prior experience of the hydraulically swaged connection system, design criteria appropriate to a North Sea Jacket Installation have been defined. The swage pile connection system offers new opportunities in offshore installation avoiding many of the problems associated with the current techniques. Such techniques have in the past been extremely diver intensive, particularly with respect to contingency procedures, whereas swaging offers a totally surface controlled diverless alternative.

14316 **Viscosity measurements of high-pressure CO/sub 2//hydrocarbon mixtures.** Kovarik, F.S.; Taylor, M.A. New York, NY; American Institute of Chemical Engineers (1987). 52p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 139A.

An oscillating quartz crystal viscometer was recently developed to measure viscosities of CO/sub 2//hydrocarbon systems over a range of conditions from 90°F to 250°F and 1000 psi to 4000 psi. This is the range of interest in carbon dioxide - enhanced oil recovery processes, and published viscosity data on these systems are rare. This crystal viscometer has been integrated into the continuous phase equilibrium apparatus (CPE), a continuous flow experiment which measures compositions and densities simultaneously and rapidly for two phases in equilibrium. Because this system operates continuously, phase equilibrium data can be generated faster than with a static equilibrium cell. Thus, the system can now simultaneously measure viscosity, density, and composition of flowing phases. A viscosity database of acceptable accuracy can be generated in a period of days that ordinarily would have taken a period of months with conventional equipment.

0204 Processing

REFER ALSO TO CITATION(S) 14135, 14152, 14157, 14170, 14171, 14173

14317 **(PB—89-137194/XAB) Control-technology assessment of petroleum-refinery operations: preliminary site visit report, Cherry Point Refinery.** (Radian Corp., Salt Lake City, UT (USA)). Apr 1982. 38p. NTIS, PC A03/MF A01.

See also PB—84-146885.

An on-site visit was made to the Cherry Point Refinery, near Ferndale, Washington, to evaluate control-technology strategies used by the refinery to control worker exposure to potentially toxic chemical agents and harmful physical agents. Specific attention was focused on naphtha reforming and oil/water separation. The facility could process up to 120,000 barrels per stream day of Alaskan North Slope crude. Efforts to control exposures included the identification of all hazardous chemical and physical agents by workplace, employee exposure assessment, control of unacceptable exposures, training and information offered, medical surveillance, and a documentation and record keeping system. Area hydrogen sulfide (7783064) monitors were located at the sulfur recovery unit and an API separator was used for oil and water separations. Several interesting control techniques noted during the visit included a closed oil-water sewer with sample points directly piped to the sewer, use of computer programs to calculate correct bolt-tightening stress, pump inspections for seal leaks, valve inspections for steam and hydrocarbon leaks, use of temperature-sensitive paints on vessels to indicate higher temperatures, and the use of acoustical testing for locating stress/corrosion cracking while the vessel was in service.

14318 **Effect of prehydrogenation on hydroconversion of Maya residuum, part I.** Reynolds, J.G.; Beret, S. New York, NY; American Institute of Chemical Engineers (1987). 25p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 46F.

Maya 650°F residuum was mildly prehydrogenated over a standard, commercially available, hydrodesulfurization catalyst. The product was then distilled to yield hydrogenated Maya 650°F residuum. This prehydrogenated residuum, and the untreated Maya 650°F residuum were separately hydroprocessed further at different process severities. The resulting products were then examined by elemental analyses to determine the effects of the prehydrogenation step on overall conversion and product quality. The primary effect of the prehydrogenation step was to increase the overall conversions for sulfur, MCR, nitrogen, and asphaltenes. As a result, the hydroconversion products derived from the prehydrogenation were substantially better quality than the corresponding direct hydroconversion products. The prehydrogenation step also lowered the severity required for equivalent residuum hydroconversion upgrading.

0206 Health And Safety

REFER ALSO TO CITATION(S) 14335, 16159, 16160

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 14338, 14487, 14873, 14874, 14875, 16841, 16902

14319 **(DOE/EIA—0109(88/11)) Petroleum supply monthly, November 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Jan 1989. 106p. NTIS, PC A06/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006476/JAW.

Total US demand for petroleum products (measured as product supplied) averaged 17.4 million barrels per day in November 1988. This is nearly 0.1 million barrels per day lower than in October but almost 1.1 million barrels per day higher than in November 1987. Total product supplied through the first 11 months of 1988 averaged 17.1 million barrels per day, 2.8 percent higher than

during the comparable period of 1987. Additionally, total product stocks increased in November to 738.7 million barrels, 4.1 million barrels above the level for October; crude oil imports, excluding those for the Strategic Petroleum Reserve (SPR) fell nearly 0.6 million barrels per day to 4.9 million barrels per day, and refinery utilization rose from a rate of 83.5 percent in October to 83.9 percent in November.

14320 **(DOE/EIA—0206(87)) Performance profiles of major energy producers, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Jan 1989. 155p. NTIS, PC A08/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006581/JAW.

The Energy Information Administration, through Form EIA-28, has collected financial information and other measures of energy-related business efforts and results for 22 major energy companies on a uniform, segmented basis. The merger of Cities Service with Occidental Petroleum in 1982 and the 1984 mergers of Chevron with Gulf Oil, Mobil with Superior Oil, and Texaco with Getty Oil reduced the number of reporting companies to 22 beginning with the 1985 reporting year. The comparability of information across energy lines of business is unique to this reporting system. For example, petroleum activities can be compared to activities in other energy lines of business or nonenergy areas, and domestic activities can be contrasted to foreign activities. The purpose of this publication is to examine year-to-year developments in the operations of the 22 major US energy-producing companies on a corporate level, by major line of energy business, by major functions within each line of business, and by geographic area. This report presents data collected on Form EIA-28 for the calendar year 1987. Although the focus is on developments in 1987, important trends over the 14-year period, 1974 through 1987, are also featured. 29 figs., 17 tabs.

14321 **(DOE/EIA—0380(88/11)) Petroleum marketing monthly, November 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 1 Feb 1989. 167p. NTIS, PC A08/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006895/JAW.

The Petroleum Marketing Monthly is prepared by the Petroleum Marketing Division, Office of Oil and Gas, Energy Information Administration. The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 12 figs., 53 tabs.

14322 (IT—1986, pp 4) **A team approach to economic evaluation.** Chobotuk, J.W. (Sceptre Resources Ltd.). 1986. Infotech, Ste. 200 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

Economic analysis from an oil company perspective is presented in outline form. Topics covered include the needs for economic analysis in the context of the current Canadian situation, the contribution that each part of the company team can play in economic analysis, the impact of the personal computer, the importance of forecasting and market realities, risk management, and finding costs and value comparisons. It is concluded that economic analysis should be used as both a predictive and an appraisal tool, that innovative ways should be sought to make economic comparisons more relevant and meaningful, and that economic evaluation should go beyond prospect analysis and provide corporate direction.

14323 **(NP—9770238) Facts - arguments. Information in brief.** (Deutsche Shell A.G., Hamburg (Germany, F.R.). Abt. Wirtschaft und Energiepolitik). Sep 1988. 15p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770238/JAW.

The present informative leaflet points out relevant data applying to the petroleum industry of the Federal Republic of Germany. A variety of diagrams serve to illustrate essential numerical data. Comparative evaluations of the present situation and preceding years are indicative of future tendencies; energy supply scenarios forecast developmental trends up to the year 2005.

14324 **Status of commercialization of alternative fuels for highway vehicles.** Ecklund, E.E. (Office of Transportation Systems, U.S. Department of Energy, Washington, D.C. (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

In spite of a petroleum glut and soft market prices, the U.S. remains vulnerable to a petroleum supply upset. In addition, the country will become increasingly dependent on Middle East oil. There are a number of options for potential extension and replacement of petroleum which are generally based on use of indigenous non-petroleum resources, including near-term substitutes propane and methane and near- or long-term alternatives hydrogen, synfuels and alcohols. Criteria for commercialization of any new fuel are presented and options discussed briefly in context thereof, including technology and market status. The more likely fuels for niche and general application are identified.

0208 Waste Management

REFER ALSO TO CITATION(S) 14157, 15170

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 14299, 14317

14325 **(SO—8507) Offshore environmental research and development related to oil and gas activities in Canada.** Thomas, D.J.; Green , G.D.; Richardson, W.S. (Seaken Oceanography Ltd., Dartmouth, Nova Scotia (Canada); Environment Canada, Ottawa, Ontario). 1985. 161p. (CONF-8502161—; MICROLOG—85-6128; CE—02157). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

From PERD 6.7 committee meeting; Calgary, Canada (11 Feb 1985).

A joint government/industry-sponsored workshop on offshore environmental research and development related to offshore oil and gas activities in Canada was held in Calgary, Alberta in 1985. The objectives of the workshop were to provide an overview of current offshore environmental R&D activities in Canada, to provide a forum for the presentation and discussion of the R&D activities and role of the Panel on Energy Research and Development (PERD), and to identify clients and to discuss their needs for offshore environmental R&D related to oil and gas activities, and priorities for future federal government R&D within the program. The main outputs of the workshop were an overview of the role of the Environment Committee in offshore R&D in Canada with emphasis on the concerns about the current status of PERD, and funding and organisational priorities for the future, a list of issues that must be addressed by all PERD projects, and a critique of procedural issues for reviewing PERD projects. Following the workshop, a PERD Committee Meeting was held to re-evaluate the Committee's role, objectives and procedures, to list selection criteria for study proposals, and to list subject areas suggested for funding. Included in the appendix are a list of attendees, a glossary, and the original background paper.

14326 (UBA-FB—87-051) Technical methods for the distribution of dispersants at sea for the treatment of oil pollution (literature review). Final report. Lompe, D.; Wiesmann, U. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Chemieingenieurtechnik; Umweltbundesamt, Berlin (Germany, F.R.)). 1987. 100p. (In German). Copy held by UB/TIB Hannover.

After an introduction about the properties of crude oils, the behavior of oil at sea and the generation of dispersions the distribution of dispersants were described. This paper presents the used systems, the fundamentals of the generation of drops and results of it. The use of this results for the distribution of dispersants were discussed. Methods for measuring the oil spill thickness for the regulation of the amount of dispersant were presented. Finally, a technical comparison of the used systems lead to proposals for technical corrections. (orig.) With 190 refs., 11 tabs., 80 figs.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 14328

14327 (ERCB—D88-18) Ladd Exploration Company, application for a well licence, Provost Field. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 1988. 10p. (CE—02283). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

An application was made by Ladd Exploration before the Energy Resources Conservation Board of Alberta for a license to drill a well to recover hydrocarbons from the Dina pool. A hearing was held to consider the views of Ladd and those affected by activities at the well site, located near a farm. Issues considered at the hearing were the need for the well, the choice of the surface and subsurface location of the well, and impacts associated with drilling, completing, testing, and producing the well. Specific concerns raised at the hearing included safety, odors, effects of possible hydrogen sulfide releases, effects of oil drilling operations on the farm's water well, and noise. The Board concluded that there would not be any major impacts associated with drilling the proposed well. It also concluded that the well, if successful, could be tested; the testing period was limited to 30 days. Ladd Exploration was expected to implement mitigating measures described in its application in order to minimize environmental impacts. However, due to the possible risk of hydrogen sulfide emissions from the site, approval for permanent production facilities at the site was not given. 1 fig.

0220 Transport, Pipelines, And Handling

14328 (NEB-SS—NE22-1/1988-5F) Reasons for decision in the matter of an application under parts 3 and 4 of the National Energy Board Act by Trans Mountain Pipe Line Company Ltd. Hearing Order OH-1-87, as amended July 1988. (National Energy Board, Ottawa, Ontario (Canada)). 1988. 62p. (In French). (CE—02286). National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, Ont., Canada K1A 0E5; $N/C.

Trans Mountain Pipe Line Company applied to Canada's National Energy Board for a two-stage expansion of its facilities and for a number of modifications to its existing toll design. Hearings were held and included examination of evidence relating to environmental and socio-economic concerns. The proposed Stage 1 expansion includes additions to 7 pump stations and the construction of 2 new pump stations and 5 new storage tanks. The Board was satisfied that this proposed expansion is in the public interest, and authorized construction of the facilities. The proposed Stage 2 facilities include the construction of 3 new pump stations and the recommissioning of 2 existing loops; this stage was designed to accommodate additional throughputs of MTBE and methanol, heavy crude, or a combination thereof. The Board did not authorize construction of Stage 2 expansion. The Board approved the applicant's proposal to roll the capital and operating costs of the Stage 1 facilities into a common rate base and revenue requirement. A means for estimating capacity surcharges and credits was determined, and surcharge and credit rates were established by the Board. The Board directed implementation of a 15% fuel and power surcharge and also directed an approach to estimate the level of fuel and power credits. Refined products special charges were eliminated for certain receiving, delivery, and transport facilities. Certain costs related to Shell-owned facilities were allocated, and the applicant was directed to develop a methodology for determining tankage credits. 1 fig., 5 tabs.

0230 Properties

REFER ALSO TO CITATION(S) 15091

14329 (FRNC-TH—3391) Separation and selective detection of sulfur compounds in heavy petroleum fractions. Geochemistry of benzo (b) thiophenes. Perakis, N. (Strasbourg-1 Univ., 67 (France)). 1986. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88756631/JAW.

Quantitative analysis of sulfur compounds in a heavy cut of ARAMCO 90 petroleum is studied for the simulation of true boiling point distillation curve. The fraction is analysed by gas chromatography. Detection by flame photometry and high resolution mass spectrometry are compared. Response of detectors shows the necessity of calibration with standard compounds in both cases. Separation of sulfur compounds by selective oxidation into sulfone and subsequent reduction for obtaining primitive sulfides is not quantitative. Nevertheless a high concentration in sulfur compounds is obtained easing qualitative analysis by gas chromatographe and flame photometry. Finally two sulfur-rich samples are studied: petroleum from Rozel Point (USA) and oil shale from Timahdit (Morocco). Identification by synthesis of mono-and dialkyl-benzo (b) thiophenes improves knowledge on sulfur compounds in geologic samples and their formation underground.

14330 The effect of equilibration time and temperature on drop-drop coalescence of Wilmington crude oil in a weakly alkaline brine. Peru, D.A.; Lorenz, P.B. New York, NY; American Institute of Chemical Engineers (1987). 44p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 36D.

The interfacial behavior of a Wilmington crude oil was studied as part of the authors' investigations of enhanced oil recovery by weakly alkaline solutions. For some systems, the spinning drop apparatus can be used to measure transient interfacial tension (IFT) effects, coalescence times of oil drops, and film rigidity simultaneously, for rapid screening of chemical slug composition for the potential of improving oil recovery by the mechanisms of oil mobilization and oil bank formation. The experimental results presented include the effects of temperature, surface age, salinity, added surfactant, and polymer on coalescence time, film rigidity, and IFT behavior. Oil displacement tests were performed using surfactant-enhanced bicarbonate solutions formulated for improved mobility control and for improved oil mobilization and oil drop coalescence. The most significant result of this work was that the authors were able to measure the dynamics in IFT between 2 coalescing oil drops as perturbations in the equilibrium concentration of surfactant at the interface occurred during film drainage. The accuracy of the technique for measuring IFT and film rigidity improved as the contact radii between the oil drops increased.

0250 Combustion

REFER ALSO TO CITATION(S) 15760

03 NATURAL GAS

0301 Reserves

14331 **(PB—89-133813/XAB) Overview of the Canadian natural gas industry. Final report, January-October 1987.** Watkins, G.C.; Blair, B.D.; Sharp, K.C.; Jones, S. (DataMetrics Ltd., Calgary, Alberta (Canada)). Nov 1987. 304p. NTIS, PC A14/MF A01.

Based on public information, the existing and projected Canadian natural gas industry was evaluated to determine the potential for exports. Natural gas reserves, production, deliverability, costs and Canadian demand were considered along with the key policy variables (protection formulas, pricing provisions, fiscal systems, and pipeline tariff formulation). The Canadian National Energy Board (NEB) forecast is based on resource estimates that do not include the potential contribution from the Canadian frontier or unconventional resources. Canadian exports to the U.S. will likely be greater than projected by the NEB.

14332 **(PB—89-136212/XAB) Natural gas resource data base for the United States (1987). Final report, June-December 1987.** Kent, H.C.; Finney, J.J. (Geological Exploration Associates Ltd., Golden, CO (USA)). Feb 1988. 163p. NTIS, PC A08/MF A01.

This data base gives a detailed summary of the estimated potential resources of natural gas in the United States, including postulated depth distributions, field sizes, well recoveries and success rates. The study (an expansion on the 1986 resource estimates of the Potential Gas Committee) analyzed the distribution and characteristics of the resource potential estimated to occur in the onshore geologic provinces of the lower 48 states, as well as the resources beneath the continental shelf and slope offshore from Louisiana and Texas. The areas that hold the greatest potential for future natural gas exploration and development include the Atlantic, Gulf Coast, Mid-Continent and Rocky Mountain areas, which contain approximately 92% of the estimated undiscovered resources. The results of the study are intended to be used to assist in making cost determinations which can be utilized in the development of supply models and in planning.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 14301, 14351

14333 **Production decline behavior of gas wells in multi-well reservoirs.** Aminian, K.; Ameri, S.; Puon, P.S. (West Virginia Univ., WV (US)); Stark, J.J. (Exxon Co. (US)); Yost, A.B. (U.S. DOE);. pp v of Proceedings of the 1988 SPE 63rd annual technical conference and exhibition. Richardson, TX; Society of Petroleum Engineers (1988). (CONF-881012—).

From 63. Society of Petroleum Engineers (SPE) annual technical conference and exhibition: reservoir engineering; Houston, TX, USA (2 Oct 1988).

This paper introduces a type curve-based method of predicting gas well production rates in multi-well reservoirs. This method was developed through applying the shape factor to gas flow equations. A finite difference gas reservoir model was utilized to evaluate and verify the shape factor application to gas wells. This model was also utilized to evaluate the type curve methodology. It was concluded that the type curve method can provide accurate predictions in multi-well gas reservoirs.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 14296, 14302, 14315, 14878

14334 **Effect of high pressure on a co-culture for the production of methane from coal synthesis gas.** Ko, C.W.; Vega, J.L.; Holmberg, V.L.; Clausen, E.C.; Gaddy, J.L. New York, NY; American Institute of Chemical Engineers (1987). 39p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 177F.

It has been demonstrated that coal synthesis gas may be converted to methane by anaerobic bacteria. One possible pathway involves the formation of acetate from carbon monoxide by bacteria such as P products. Acetate can be reacted to methane by methanogens, such as Methanotrix sp. A second pathway involves the use of R rubrum to convert carbon monoxide to hydrogen and carbon dioxide which is then converted to methane by methanogen species such as Methanobacterium formicicum. Whenever a gas needs to react in a liquid phase, reaction rates are severely limited by mass transfer of the gaseous substrates into the liquid medium. Operation at high pressure increases the gas transport and solubility and, thus, the reaction rates. However, high concentrations of dissolved carbon monoxide are known to decrease or completely inhibit metabolic activity. This paper examines the effects of high pressure on the performance of co-cultures capable of converting synthesis gas into methane.

0305 Health And Safety

14335 **(ERCB—IL88-14) Evaluation and ignition for sour wells.** Strom, N.A. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 1988. 3p. (CE—02113). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C.

Alberta policy is outlined for emergency evacuation and ignition of sour gas and oil wells during drilling, completion, servicing, and production. The policy is designed to protect the public in the case of uncontrolled or partially controlled releases of hydrogen sulfide gas from such wells. Evacuation is the preferred alternative, and evacuation procedures on the well site and in the emergency planning zone are in accordance with the well operator's approved plans. Evacuation outside the zone would be handled by the provincial Sour Gas Release Plan; guidelines are presented, according to hydrogen sulfide concentration, as to appropriate action in these cases. Two general situations are identified which would require ignition: where uncontrolled releases occur from wells that have very high potential hydrogen sulfide release rates and are located near population centers where evacuation would not be possible; and where other releases occur in locations where evacuation is not practical and where the health and safety of people is at risk.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 14287, 14331, 14332, 14873, 14874, 14875, 15001

14336 **(DOE/EIA—0130(88/11)) Natural gas monthly, November 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Jan 1989. 140p. NTIS, PC A07/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006890/JAW.

Gross withdrawals of natural gas (wet, after lease separation) from gas and oil wells in the United States during November 1988, were estimated at 1755 billion cubic feet, 1.3 percent above withdrawals during November 1987. Of the total quantity, an estimated 215 billion cubic feet were returned to gas and oil reservoirs for repressuring, pressure maintenance, and cycling; 35 billion cubic feet of nonhydrocarbon gases were removed; and 13 billion cubic feet were vented or flared. The remaining wet marketed production totaled 1492 billion cubic feet. Dry gas production (wet marketed production minus 70 billion cubic feet of extraction loss) totaled an

estimated 1422 billion cubic feet, similar to the November 1987 level. The total dry gas supply available for disposition in November 1988 was estimated at 1702 billion cubic feet, including 173 billion cubic feet withdrawn from storage, 12 billion cubic feet of supplemental supplies, and 95 billion cubic feet that were imported. In November 1987, dry gas available for disposition totaled 1684 billion cubic feet. Of the total dry gas supply available for disposition in November 1988, an estimated 1467 billion cubic feet were consumed, 148 billion cubic feet were injected into underground storage reservoirs, and 5 billion cubic feet were exported, leaving 82 billion cubic feet unaccounted for.

14337 **(PB—89-133821/XAB) Canadian natural gas export capability. Topical report.** (DataMetrics Ltd., Calgary, Alberta (Canada)). Jul 1988. 50p. NTIS, PC A03/MF A01.

The future export capability of the Canadian natural gas industry is studied, using the National Energy Board's analysis but also allowing for supplies from frontier and nonconventional sources. A model is used to predict export capability of the various supply-demand outlooks generated by three different petroleum price projections. The impact of price levels, demand responses, supply responses, policy parameters, and the availability of frontier and nonconventional gas reserves is examined. GRI's 1987 Baseline Projection of Canadian exports to the U.S. and possible implications of the U.S.-Canadian Free Trade Agreement are reviewed.

14338 **RAMSGAS.** Hicks, E.; Conopask, J.V.; Mihlmester, P.E. (Applied Management Sciences, Inc., Oak Ridge, TN (US)); Reisfer, D.B.; Trowbridge, L.D.; Pin, F.G. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

With hardware and software enhancements in recent years, it has become possible to utilize generic, highly user friendly software packages to greatly facilitate analysis and planning applications on microcomputers for use directly by planning and decision-making personnel. In 1984, staff at Applied Management Sciences began to investigate the use of generic software, such as the electronic spreadsheet, for analyzing complex energy economic issues. The use of LOTUS 1-2-3/sup TM/ spreadsheet software for a major modeling application, utilizing a first principles approach, was demonstrated. The Office of Fossil Energy, working with staff from Applied Management Sciences and Oak Ridge National Laboratory, embarked upon the development of a planning framework which would allow R and D program decisions to be made in conjunction with data and analyses on long-term energy markets and energy demand for different fuel types. In this way, R and D programs could be targeted toward technologies which showed promise of producing fuels which could ultimately compete. The R and D could also be oriented toward developing these technologies over a suitable timeframe which would allow the mature technology to enter the market at the appropriate time. To assist in meeting these planning needs, the R and D Analysis Modeling System (RAMS), and the initial component of RAMS, a world oil model known as RAMSOIL, was developed.

0307 Waste Management

REFER ALSO TO CITATION(S) 14320

14339 **(BVRS/WRD—7807) Claus plant waste gas incinerators.** Ritter, R.A. (Bow Valley Research Ltd., Calgary, Alberta (Canada)). 1978. 115p. (CE—02219). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This project was concerned with an assessment of one approach to energy conservation involving recovery, by means of recuperative heat exchange between stack gas and the entering tail gas, of part of the energy normally lost in the stack of a Claus sulfur plant waste gas incinerator. Theoretical analysis of the incineration process showed that the energy consumed was uniquely related to the stack gas temperature and component flow rates. Results of the analysis indicated that, at acceptable combustion and stack gas temperatures, input energy reductions of ca 50% were attainable with a realistic heat exchanger efficiency of 50%. An experimental program was used to confirm the theoretical predictions, to ensure that complete incineration was achieved, and to assess the durability of varous heat exchanger materials. A laboratory scale incinerator was constructed to be operable in both the conventional and recuperative heat exchange modes. The results showed the recuperative mode was superior, in all important aspects, to the conventional mode. Under rather modrate and familiar levels of compustion temperature and excess oxygen, despite a decrease in residence time, virtually complete incineration of tail gas was assured. Heat exchanger efficiencies and energy savings approximated the theoretically predicted values. The alonized steel used in the model displayed adequate corrosion resistance except at the location of a weld. 22 figs., 8 tabs.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 14325

14340 **(NP—9770231) Earth crust movement analysis around Groningen, Netherlands.** Oskam, D. (Afdeling Geodesie TH-Delft (Netherlands)). 1986. 129p. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89770231/JAW.

As part of measurements of drop in the level of the land above the gas field in Groningen, Netherlands, the NAM (Dutch Oil Company) also carries out subsidence measurements (i.e. settling of the soil). On 14 location the changes in thickness of the top earth crust (400 meters), the quaternary formation, are measured. The daily settling measurements are influenced by different factors, like the tides and the weather conditions. On the basis of a tide analysis the influence has been investigated. The influence of earth tides on settling measurements could not be proved. For the 5 coast locations the influence of the sea tides has been showed. The influence of the weather conditions and the groundwater level on the compactness/dilatation of the quaternary formation and the settling measurements is indicated briefly. 29 figs., 9 refs., 7 tabs., 4 app.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 14351

14341 **Production forecasts for alternative completion methods in low-permeability gas reservoirs.** Duda, J.R. (U.S. DOE (US)); Kumar, H.K. (Reservoir Simulation Research Corp. (US));. pp v of Proceedings of the 1988 SPE 63rd annual technical conference and exhibition. Richardson, TX; Society of Petroleum Engineers (1988). (CONF-881012—).

From 63. Society of Petroleum Engineers (SPE) annual technical conference and exhibition: reservoir engineering; Houston, TX, USA (2 Oct 1988).

Recently, there has been a heightened interest in the use of horizontal wells to more efficiently drain both oil and gas reservoirs and to compensate for negative producing situations such as coning. The potential applications of horizontal and high-angle wells have led to increased efforts to quantify the expected production increase from these types of completion methods in a variety of geologic settings. Simulation of these alternative completion methods using mathematical models provides a cost-effective method of predicting their performance and allows for sensitivity analysis of reservoir properties. The performance of horizontal and high-angle completions was simulated for marginal marine and lenticular low permeability gas reservoirs of the Upper Cretaceous Mesaverde Formation underlying the east-central Piceance Basin. Results of the simulations show that production from horizontal wells of intermediate length can be expected to be four times higher that that of vertical, stimulated wells draining large areas. The advantages of high-angle wells in lenticular sandstone environments remain unquantified, but a reasonable potential exists, especially when methane from deeply buried coals is considered.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 14878

14342 **(APUB—E88090) Natural gas transportation service to small industrial customers.** (Alberta Public Utilities Board, Edmonton (Canada)). 1988. 92p. (CE—02289). Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, , Canada T5J 2Y2; $N/C.

A hearing was held before the Alberta Public Utilities Board to consider various issues related to the provision of gas service by Northwestern Utilities and Canadian Western Natural Gas to small industrial customers. These issues included balancing provisions and settlement penalties related to imbalances in gas deliveries; the costs to be considered in determining rates for transportation service; charges for points of receipt and delivery; contract demand periods; allowance of, and charges for, authorized overruns in delivery; transportation service rates for customers using sales service rate 2; and types and conditions of service. Among the decisions of the Board in these matters are the following directions to the utilities: to monitor and report the daily receipts, deliveries and imbalances of each customer using the rate schedule considered in this hearing; to provide authorized overrun service on an interruptible basis during the winter months; and to set up a reserve account to account for revenues arising from overrun and interruptible transportation service. A rate structure is included in the appendix.

14343 **(ERCB—D-88-14) Manalta Coal Ltd., Request for Board order of a well abandonment/Chinook Management Ltd.. Application for permit for pipeline construction.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 1988. 16p. (CE—02287). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

An application was made by Manalta Coal to the Alberta Energy Resources Conservation Board for an order to require Chinook Management to abandon its Red Willow 6-13 gas well so that coal could be mined through the well site. Another application was made by Chinook to construct a pipeline from the 6-13 well. The coal company objected to the pipeline as it could interfere with mining operations. Both applications were considered at a hearing before the Board and a number of interrelated issues were addressed. It was realized that there would be interference between the coal and gas operations, no matter what decision was reached, and there was agreement that the optimum decision would be one in which there would be minimum cost impacts and also the lowest practical level of interference of one operation upon the other. The key issues addressed at the hearing were: identification of the major aspect of interference between the two operations and the most practical way of overcoming that interference; the cost impacts of the options proposed; safety aspects that might render any of the options unacceptable; and which option would provide the most reasonable opportunity for development of both resources. It was decided to approve one of the options, which required temporary well abandonment to allow mining, with production resumed in 1993. The pipeline was also approved, according to the alternative route as proposed in the application. Part of this pipeline would have to be abandoned and re-routed simultaneously with the temporary suspension of the 6-13 well. Allocation of costs among the different parties is also set out. 1 fig., 2 tabs.

14344 **(NEB-SS—NE-22-1/1988-8F) St. Clair Pipelines Ltd. and TransCanada PipeLines Limited. Application to authorize the construction of facilities to transport gas across the St. Clair River.** (National Energy Board, Ottawa, Ontario (Canada)). 1988. 24p. (In French). (CE—02284). National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, Ont., Canada K1A 0E5; $N/C.

Application was made before Canada's National Energy Board by St. Clair Pipelines, relating to the construction of a gas pipeline to the USA across the St. Clair River. A related application, by way of proposing an alternative to the said pipeline, was made by TransCanada PipeLines for construction of facilities to provide added transportation service to Union Gas and other local companies. A hearing was conducted at which a number of issues were considered, including Union's gas supplies and markets, security and flexibility of supply, the ability of existing connections across the St. Clair River to fulfill gas supply/demand needs, the capacities of the respective pipelines, the providing of increased competition among gas suppliers, accessibility to shippers, and environmental impacts of pipeline construction and operation. It was decided that St. Clair's proposed facilities would provide eastern Canadian gas users with a direct connection to major gas-producing regions in the USA, and would thereby enhance diversity of supply. The facilities were seen to provide for gas flow in either direction, thus enhancing operating flexibility and contributing to a more effective and efficient operation of pipeline systems. The proposed facilities would offer Canadian producers access to new export markets. Existing transborder connections could not provide the capabilities of the proposed line. Environmental concerns were seen to be minimal, provided that the directionally drilled construction technique as proposed in the application is successful and sound environmental policies are practised. TransCanada's alternative was not found to be in the public interest. 1 fig.

14345 **(NEB-SS—NE22-1/1988-8E) St. Clair Pipelines Ltd. and TransCanada PipeLines Limited. Application to authorize the construction of facilities to transport gas across the St. Clair River.** (National Energy Board, Ottawa, Ontario (Canada)). 1988. 22p. (CE—02285). National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, Ont., Canada K1A 0E5; $N/C.

Application was made before Canada's National Energy Board by St. Clair Pipelines, relating to the construction of a gas pipeline to the USA across the St. Clair River. A related application, by way of proposing an alternative to the said pipeline, was made by TransCanada PipeLines for construction of facilities to provide added transportation service to Union Gas and other local companies. A hearing was conducted at which a number of issues were considered, including Union's gas supplies and markets, security and flexibility of supply, the ability of existing connections across the St. Clair River to fulfill gas supply/demand needs, the capacities of the respective pipelines, the providing of increased competition among gas suppliers, accessibility to shippers, and environmental impacts of pipeline construction and operation. It was decided that St. Clair's proposed facilities would provide eastern Canadian gas users with a direct connection to major gas-producing regions in the USA, and would thereby enhance diversity of supply. The facilities were seen to provide for gas flow in either direction, thus enhancing operating flexibility and contributing to a more effective and efficient operation of pipeline systems. The proposed facilities would offer Canadian producers access to new export markets. Existing transborder connections could not provide the capabilities of the proposed line. Environmental concerns were seen to be minimal, provided that the directionally drilled construction technique as proposed in the application is successful and sound environmental policies are practised. TransCanada's alternative was not found to be in the public interest. 1 fig.

0340 Combustion

REFER ALSO TO CITATION(S) 15078

04 OIL SHALES AND TAR SANDS

14346 **(EMR—8410) A review of heavy oil & bitumen production in Canada.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1984. 79p. (CE—02130). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Canadian deposits of oil sands (bitumen) are found in Peace River, Wabasca, Athabasca and Cold Lake, changing to heavy oils in Lloydminster and south along the Alberta-Saskatchewan border through Wainwright, Colville, Suffield and Taber. Total bitumen in-place is about one trillion barrels and over 10 billion barrels for the heavy oils. Current production of bitumen is about 33,500 bbl/d and could rise to 140,000 bbl/d from existing projects. Undiluted heavy oil production from Alberta and Saskatchewan is about 176,000 bbl/d of which over 25% is from Lloydminster. There are

86 approved heavy oil and bitumen extraction operations, including Syncude and Suncor, of which 48 are in oil sands experimental projects, 22 heavy oil projects in Alberta and 14 projects in Saskatchewan. Technologies used are surface mining and cyclic steam injection (huff and puff) for bitumen and steam and fireflooding for heavy oils. The use of mine shafts for bitumen recovery instead of surface mining is being tested to avoid overburden removal and sand handling. Economic studies indicate higher rates of return from heavy oil steam cycle/drive at Lloydminster, bitumen mine shaft drainage at Athabasca (38%), and bitumen steam cycle/drive at Cold Lake (25%), than from heavy oil fireflood at Lloydminster (19%) and surface mining at Athabasca (18%). The greatest potential for large and commercially viable production is at Cold Lake. New surface mining projects are constrained by the large capital investment and operational costs, oil price risks, and environmental problems. A combination of mine shaft and steam thermal recovery may be the way to reduce costs. It is estimated that 50 billion bbl of heavy oils and bitumen are recoverable by existing technology. 8 refs., 18 figs., 6 tabs.

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 14341

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 14352, 14353

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 14341

14347 **(DOE/MC/11076—2625) Thermal decomposition of Colorado and Kentucky reference oil shales.** Miknis, F.P.; Turner, T.F.; Ennen, L.W.; Chong, S.L.; Glaser, R. (Western Research Inst., Laramie, WY (USA)). Jun 1988. Contract FC21-86MC11076. 53p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE88010286/JAW.

Isothermal pyrolysis studies have been conducted on a Green River Formation oil shale from Colorado and a New Albany oil shale from Kentucky. The conversion of kerogen to bitumen, oil, gas, and residue products was obtained for different isothermal reaction times in the temperature range of 375{degree}C to 440{degree}C (707{degree} to 824{degree}F) using a heated sand bath reactor system. Particular attention was paid to the formation of the bitumen intermediate during decomposition of the two shales. The maximum amount of extractable bitumen in the New Albany shale was 14% or less of the original kerogen at any given temperature, indicating that direct conversion of kerogen to oil, gas, and residue products is a major pathway of conversion of this shale during pyrolysis. In contrast, a significant fraction of the Colorado oil shale kerogen was converted to the intermediate bitumen during pyrolysis. The bitumen data imply that the formation of soluble intermediates may depend on original kerogen structure and may be necessary for producing high yields by pyrolysis. 24 refs., 14 figs., 8 tabs.

14348 **(DOE/MC/11076—2638) Characterization and treatment of by-product waters from selected oil shale retorting tests.** Nordin, J.S.; Poulson, R.; Niss, N.; Laya, C. (Western Research Inst., Laramie, WY (USA)). Dec 1987. Contract FC21-86MC11076. 87p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000914/JAW.

Oil shale retorting by-product waters from four surface retorting pilot tests and three simulated modified in situ retorting pilot tests were characterized for inorganic and organic chemical constituents. Eastern and western US shales were retorted for the tests. Ammonium bicarbonate, ammonium thiosulfate, various pyridines, and phenolic species were among the principal contaminants in the retort by-product water. The water also contains total dissolved solids up to 7000 ppM. When steam was used as a source of heat for oil shale retorting, the condensate that formed diluted the concentrations of contaminants, especially mineral dissolved solids, in the by-product water. The combined water treatment steps of hot-gas stripping followed by wet air oxidation at 600{degree}F (315{degree}C) and 2000 psi for 30 minutes removed 99% of the total organic carbon in the retort by-product water, producing a colorless and almost odor-free water. In one treatment test, the total organic carbon (TOC) was reduced from 3400 mg/L to less than 20 mg/L, with the 20 mg/L TOC remaining consisting of low molecular weight carboxylic acids. Only a partial TOC reduction occurred, with various alkylpyridines remaining as residuals when the retort waters were subjected to wet air oxidation as the only treatment step. Electrocoagulation as an initial water treatment step removed less than 30% of the TOC. 10 refs., 4 figs., 12 tabs.

14349 **(DOE/MC/22134—2634) Moving vertical bed retorting of Colorado oil shale.** Gaire, R.J.; Mazzella, G. (Foster Wheeler USA Corp., Clinton, NJ). May 1988. Contract AC21-86MC22134. 716p. NTIS, PC A99 - OSTI. Order Number DE88010294/JAW.

This topical report summarizes the conceptual design of an integrated oil shale processing plant based on moving vertical-bed retorting of Colorado oil shale. This is the third design case conducted by Foster Wheeler. The plant has a nominal capacity of 50,000 barrels per operating day of syncrude product, derived from oil shale feed having a Fischer Assay of 30 gallons per ton. The scope of the plant encompasses a grassroots facility which receives run of the mine oil shale, delivers product oil to storage, and disposes of the processed spent shale. In addition to oil shale feed, the battery limits input includes raw water, electric power, and natural gas to support plant operations. Design of the individual processing units was based on non-confidential information derived from published literature sources and supplemented by input from selected process licensors. The integrated plant design is described in terms of the individual process units and plant support systems. The estimated total plant investment is detailed by plant section and estimates of the annual operating requirements and costs are provided. In addition, the process design assumptions and uncertainties are documented and recommendations for process alternatives, which could improve the overall plant economics, are discussed. 10 refs., 29 figs., 82 tabs.

14350 **Inorganic solute profiles of waters related to an in situ oil shale retort.** Poulson, R.E.; Borg, H.M. (Western Research Institute, Laramie, WY (US));. *In Situ;* **12**: No. 3, 181-208(1988).

Water samples were taken from an in situ oil shale retorting site approximately three and one-half years after the shutdown of the oil recovery phase, and after intermittent flooding and pumpdown of the retort cavity had occurred. Waters from within and without the retort were compared using a battery of analyses for inorganic and general water quality. Six inorganic parameters found to qualify as potential key indicators for retort water migration from that site are: potassium, lithium, ammonia, fluoride, thiosulfate and boron. Except for ammonia, these indicators differ from those selected by other researchers at other modified in situ retorting sites. Al of the indicators except thiosulfate were detected in the Mahogany Zone "B" groove completion of the downgradient well at concentration slightly above those of the control wells. However, insufficient historical baseline data is available at the low detection levels required to allow positive inference of communication between this well and the retort. The detection limits for ammonia an lithium are demonstrated to the fractional part per billion level. The potential for enhancemet of sensitivity of the ion chromatographic methods used for all of the indicators except boron (which was determined spectroscopically) is discussed.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 14211, 14341, 14347, 14349, 14350, 15563

14351 **Insights and contributions from the multiwell experiment.** Northrop, D.A. (Sandia Natl. Labs. (US)); Frohne, K.H. (U.S. DOE (US));. pp v of Proceedings of the 1988 SPE 63rd annual technical conference and exhibition. Richardson, TX; Society of Petroleum Engineers (1988). (CONF-881012—).

From 63. Society of Petroleum Engineers (SPE) annual technical conference and exhibition: reservoir engineering; Houston, TX, USA (2 Oct 1988).

The U.S. Department of Energy's Multiwell Experiment (MWX) has led to insights and contributions into the technology for natural gas production from low permeability sandstone reservoirs in the western United States. Three wells, between 110 and 215 ft (34-66 m) apart at depth, have been drilled in the Miceance Basin of Colorado, where the Cretaceous-age Mesaverde, the formation of interest, lies at a depth of 4,000 to 8,250 ft (1220-2520 m). Tests have been conducted in the lowermost Corcoran-Cozzette marine sandstones and in the overlying paludal, coastal, and fluvial nonmarine intervals. Insights were gained in the areas of: (1) depositional environments, (2) natural fractures, (3) techniques for accurate reservoir assessment, (4) effectiveness of hydraulic fracturing, and (5) in situ stress behavior. Contributions to technology include: (1) improved core analysis capability, (2) demonstration of Stratapax core bits, (3) importance of depositional environments and natural fractures to tight Mesaverde production, (4) a computerized log analysis system and service, (5), new stress testing procedures, (6) detailed geologic and reservoir model for the Mesaverde, (7) factors affecting frac design, and (8) a comprehensive technical database for the Mesaverde. The paper draws upon several years of MWX results to illustrate these insights and contributions which have enhanced industry's ability to recover gas from this large resource.

14352 **Simulation of rock fracture with the 3-D shale code.** Nichols, B.D.; Adams, T.F. (Los Alamos Nat. Lab., Los Alamos, NM (US));. pp v of Rock masses: Modeling of underground openings; probability of slope failure; fracture of intact rock. Dowding, C.H. New York, NY; American Society of Civil Engineers (1986). (CONF-8504323—).

From Rock masses: modeling of underground openings, probability of slope failure, fracture of intact rock; Denver, CO, USA (29 Apr 1985).

The 3-D SHALE code simulates the propagation of stress waves and the occurence of fracture in brittle solids. The physical models and numerical methods in this code are similar to those used in 2-D SHALE. The authors describe the 3-D code and present sample calculations for blasting in oil shale with a single isolated charge, an infinite array of charges, and an isolated pair of charges. These calculations illustrate the use of the code to simulate dynamic phenomena in complex geometric configurations. Some useful code improvements and possible applications are discussed.

14353 **Oil shale fracture characterization by a new model.** Chong, K.P.; Kruppa, M.D. (Univ. of Wyoming, Laramie, WY (US));. pp v of Rock masses: Modeling of underground openings; probability of slope failure; fracture of intact rock. Dowding, C.H. New York, NY; American Society of Civil Engineers (1986). (CONF-8504323—).

From Rock masses: modeling of underground openings, probability of slope failure, fracture of intact rock; Denver, CO, USA (29 Apr 1985).

Fracture toughness of oil shale is a property which is essential for fracture characterization needed for energy resource development and recovery. However, a data base for fracture toughness is still nonexistent. Oil shale is a layered material more accurately characterized as transversely isotropic. The senior author proposes to use a semi-circular core specimen with an edge crack subjected to three-point bending, in order to overcome extensive machining and other difficulties associated with using standard fracture mechanics test specimens for testing rock. The effect of crack length on the normalized stress intensity factor for the proposed geometry is investigated by strain energy method, ellipse method, and stress method. The fracture load is obtained by compressing the specimen to failure. The fracture toughness is determined for different oil yields for Utah oil shales using compliance and other methods. Comparison is made against existing published data. It was observed the richer the oil shale, the higher is the fracture toughness. For complete characterization and statistical analysis, more data are needed.

0407 Health And Safety

REFER ALSO TO CITATION(S) 16160

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 14883

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 15481, 15491

14354 **(CNEA-NT—35/87) Environmental planning in uranium milling.** Bertello, L.F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Consejo Asesor de Licenciamiento de Instalaciones Nucleares). (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1987. 31p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705319/JAW.

Effluents from uranium milling in the Achala region in the province of Cordoba are studied. Liquids from lixiviation-recovery and from precipitation-washing of yellow-cake were analyzed. Separation of both liquids before treatment and disposal is recommended. Data of the hydric environment are presented specially for volumes of flow. The disposal criteria established by the provincial authorities are presented, and discussed. Calculations to define the effects on the environment of two types of effluents (the leaching effluent without treatment and the same after treating it) on two points of the rivers net, are given and the results discussed. A disposal policy for a treated effluent of mean composition is presented, based on two different amounts for the two phases of the river flux; the possible effects on two points of the net were also calculated. In the author's opinion, such policy will result in a disposal without a sensible damage in the receptor.

0504 Feed Processing

14355 **(FMPC/Sub—019) Uranium emissions from gulping of uranium trioxide.** Semones, T.R.; Sverdrup, E.F. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center; Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Dec 1988. Contract AC05-86OR21600. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006793/JAW.

An estimate of the quantities of uranium released from the Plant 2/3 system for vacuum transfer of UO_3over the 35 year operating history of the plant has been made. The estimate is based on uranium production records, recent measurements of the uranium content of mists reentrained from the scrubbing system, combined measurements of mist and particulate emissions that occur when the contents of a denitration pot are gulped, and the collection efficiency expected from the particle control train. With only the scrubber system operating, stack sampling tests indicate that the contribution of entrained uranium in the scrubber mist to total stack emissions averaged 0.14 kg uranium per hour of scrubber operation. A second set of measurements yielded the rate of uranium loss from the stack due to both mist entrainment and to fine particles escaping from the gulping system particle control train. The rate of uranium loss from the stack averaged 0.27 kg uranium per hour of gulping operations. These measurements, coupled with production data, yield emissions of 38,600 kilograms of uranium over the operating history of the plant.

14356 **A comparison of processes for the conversion of uranyl nitrate into ceramic-grade UO/sub 2/.** Haas, P.A. (Oak Ridge National Lab., Chemical Technology Div., P.O. Box X, Oak Ridge, TN (US));. *Nuclear Technology;* **81**: No. 3, 393-406(Jun 1988).

The preferred processes for converting uranyl nitrate solutions into UO/sub 2/ for the fabrication of nuclear fuel pellets all involve the thermal decomposition of solid compounds into UO/sub 3/ without melting. Criteria for comparisons are given and used to compare eight conversion processes. Costs for the conversion processes are estimated to be 60 to 108% of the costs for the most commonly used ammonium diuranate precipitation/calcination process.

0505 Uranium Enrichment

14357 (K/HS—205) ORGDP health and safety long-range management plan: Executive summary. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1988. Contract AC05-84OT21400. 186p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006475/JAW.

This document outlines those health and safety actions and costs which will be required to meet increased numbers of regulations and more stringent regulations. This document is not intended to be a budget document; however, it is intended to provide guidance to both Martin Marietta Energy Systems, Inc. (Energy Systems) and Department of Energy (DOE) management as to the near order of magnitude of the resources (primarily funding requirements) and the time frame required to execute the strategy in the present revision of the plan. It is not, in all cases, in agreement with current budget (funding) requests and obligations for these immediate years. Beyond the immediate time frame, the document reflects the strategy and the project and funding estimates as a snapshot at the time of publication. The health and safety areas of all industry in general and the nuclear industry, in particular, are rapidly changing as more restrictive health and safety regulations are promulgated.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 14438, 14439, 14440, 14442, 14447, 14665, 15171

14358 (DPST—88-1006) Crush strength of encapsulated microspheres. Marra, J.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 15 Dec 1988. Contract AC09-76SR00001. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006759/JAW.

The use of coated microsphere fuels has been suggested for the Savannah River Plant's (SRP) operating reactors as well as for the Low-Temperature Heavy-Water (LTHW) New Production Reactor (NPR). A program is underway to examine the feasibility of incorporating coated microsphere fuels into the well developed powder metallurgy (PM) fuel fabrication process. The coated microspheres were developed for use in the High-Temperature Gas-Cooled Reactor (HTGR). The reference fuel (Triso-coated) for the HTGR consists of an uranium oxycarbide kernel encapsulated in a porous pyrolytic carbon buffer, a dense pyrolytic carbon inner layer (IPyC), a SiC layer, and a dense pyrolytic carbon outer layer (OPyC). For the microspheres to contain gaseous fission products, less than one particle in 1000 can fail during fabrication and/or irradiation. Early SRL efforts have shown that conventional Triso-coated particles do not survive fabrication by PM². Measurements of the crush strength of coated microspheres show that removal of either the pyrolytic carbon buffer or the outer pyrolytic carbon layer lowers the fracture resistance of the microspheres. These results indicate that Triso coated microspheres are more likely to fracture during fabrication of SRP fuel if the microspheres are down sized by removal of either of the pyrolytic carbon layers.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 14366, 14448, 14455, 14458

14359 (CEA-R—5467) Calibration method for the on-line analysis of iodine and organo-iodides in the gaseous phase by laser-induced fluorescence. Remy, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques). Oct 1988. 35p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756661/JAW.

On line monitoring of low level of iodine in gaseous wastes can be done by laser induced fluorescence. The object of this study is to define the on line analytical procedure, that would permit the discrimination between inorganic iodine and organic iodine and set low level standard of organic. A calibration curve for the different vapor pressure of molecular iodine has been made till 10/sup -5/ mmHg. Organic iodine is measured afterwards on line mineralisation by pyrolytic oxidation.

14360 (CONF-890304—3) Advanced servomanipulator remote maintenance demonstration. Bradley, E.C.; Ladd, L.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89001155/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Fuel Recycle Division (FRD) of the Oak Ridge National Laboratory (ORNL) is developing remote maintenance systems for the Consolidated Fuel Reprocessing Program for applications in future nuclear fuel cycle facilities. The most recent development is the advanced servomanipulator (ASM), a digitally controlled, force-reflecting, dual-arm, master/slave servomanipulator. A unique feature of ASM is that the slave arms are remotely maintainable. The ASM slave arms are composed of modules, each of which is capable of being removed and replaced by another manipulator system. The intent of this test was to demonstrate that the ASM slave arms could be completely disassembled and reassembled remotely. This remote maintenance demonstration was performed using the Remote Operations and Maintenance Demonstration (ROMD) facility model M-2 servomanipulator maintenance system. Maintenance of ASM was successfully demonstrated using the M-2 servomanipulator and special fixtures. Recommendations, generally applicable to other remotely maintained equipment, have been made for maintainability improvements. 3 refs., 5 figs.

14361 (CONF-890304—4) Performance evaluation of the Oak Ridge National Laboratory's advanced servomanipulator. Draper, J.V.; Schrock, S.L.; Handel, S.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89001352/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Consolidated Fuel Reprocessing Program (CFRP) at the Oak Ridge National Laboratory (ORNL) is developing technology for future nuclear fuel reprocessing facilities. This responsibility includes developing advanced telerobotic systems for repair and maintenance of such facilities. In response to a requirement for a highly reliable, remotely maintainable manipulator system, CFRP designed and built the advanced servomanipulator (ASM). This paper reports resuits of a recent comparison of ASM's performance to that of another highly dexterous manipulator, the Sargeant Industries/Central Research Laboratory's (CRL's) model M-2. Operators using ASM were able to complete tasks in about the same amount of time required to complete tasks with the CRL M-2. 13 refs., 5 figs., 2 tabs.

14362 (CONF-890304—5) Remote automated sampler development. Evans, J.H.; Schrock, S.L.; Mouring, R.W. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89001351/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

This paper describes the development and present status at the Oak Ridge National Laboratory (ORNL) of automated sampling systems for fuel reprocessing applications. The concept being developed uses a self-propelled vehicle that traverses the periphery of the process cell on a track system and collects sample bottles from track-mounted sample stations. Design features of the mechanical hardware and control system and the results of functional and maintainability tests on several generations of these sampling systems are described. 11 figs., 2 tabs.

14363 **(CONF-890304—7) Design features and remote maintenance test results for equipment racks designed for reprocessing cell applications.** Schrock, S.L.; Chesser, J.B.; Peishel, F.L. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 12p. NTIS, PC A03 - OSTI. Order Number DE89002198/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

This paper describes a concept for equipment rack design and cell placement for highly radioactive process cells developed by the Consolidated Fuel Reprocessing Program (CFRP) at the Oak Ridge National Laboratory (ORNL). This concept takes advantage of the dexterity and mobility of advanced bridge-mounted, force-reflecting servomanipulators to minimize cell size and increase facility availability. Several prototype racks have been fabricated and maintenance demonstrations have been performed on equipment mounted on these racks. The results of these tests are also described in this paper. 3 refs., 6 figs.

14364 **(CONF-890304—8) A flexible controls architecture that supports servomanipulator development.** Noakes, M.W.; Corbett, G.K.; Kring, C.T. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 14p. NTIS, PC A03 - OSTI. Order Number TI89002193/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

This paper describes a hardware and software controls approach to a servomanipulator design that allows research and development modifications to be easily made and still retain the integrity of operations software. The controls hardware and software are explained in enough detail to reveal the major philosophical approach necessary in creating a development system. The effectiveness of this concept is proven with a summary of experimental work to date including teach/playback robotics, a study of manipulator-operator frequency response requirements, simulated time delay teleoperations, and simple real-time expert systems applications. 3 refs., 8 figs.

14365 **(CONF-890304—9) Design of remote maintenance tooling and fixtures for the advanced servomanipulator remote maintenance demonstration.** Arakawa, P.E.; Williams, D.M.; Bradley, E.C. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 17p. NTIS, PC A03 - OSTI. Order Number DE89003114/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The basic approach for design of remotely maintainable equipment is to incorporate individually replaceable modules. These modules typically possess features that will enhance remote handling, such as captive cone-head fasteners, tapered guides, remotely operated disconnects, and lift points that allow the modules to be oriented in the proper position. The use of special fixtures or tooling to accomplish remote maintainability is usually discouraged due to the added storage and handling requirements for these items. However, due to the complex nature of some equipment and the associated maintenance requirements, special tooling/fixtures may be required for some maintenance tasks. A number of fixtures were fabricated and used on the advanced servomanipulator (ASM) maintenance demonstration. Details of the actual experimental task are given in a companion paper in this meeting entitled "Demonstration of Remote Maintenance of the Advanced Servomanipulator." This paper describes the various fixtures used and the special functional requirements that influenced their design. The remote maintenance demonstration was successfully performed using these fixtures. 2 refs., 9 figs.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 14452, 14669

14366 **(DOE/RL—88-34) Spent fuel storage requirements, 1988.** (USDOE Richland Operations Office, WA). Oct 1988. Contract AC06-76RL01830. 70p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006574/JAW.

Historical inventories of spent fuel and Department of Energy (DOE) estimates of future discharges from US commercial nuclear reactors are presented for the next 20 years, through the year 2007. The eventual needs for additional spent fuel storage capacity are estimated. These estimates are based on the maximum capacities within current and planned at-reactor facilities and on any planned transshipments of fuel to other reactors or facilities. Historical data through December 1987 and projected discharges through the end of reactor life are used in this analysis. The source data was supplied by the utilities to DOE through the 1988 RW-859 data survey and by DOE estimates of future nuclear capacity, generation, and spent fuel discharges. 12 refs., 3 figs., 28 tabs.

14367 **(PNL—6640-Vol.1) Storage of LWR spent fuel in air: Volume 1: Design and operation of a spent fuel oxidation test facility.** Thornhill, C.K.; Campbell, T.K.; Thornhill, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 55p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006696/JAW.

This report describes the design and operation and technical accomplishments of a spent-fuel oxidation test facility at the Pacific Northwest Laboratory. The objective of the experiments conducted in this facility was to develop a data base for determining spent-fuel dry storage temperature limits by characterizing the oxidation behavior of light-water reactor (LWR) spent fuels in air. These data are needed to support licensing of dry storage in air as an alternative to spent-fuel storage in water pools. They are to be used to develop and validate predictive models of spent-fuel behavior during dry air storage in an Independent Spent Fuel Storage Installation (ISFSI). The present licensed alternative to pool storage of spent fuel is dry storage in an inert gas environment, which is called inerted dry storage (IDS). Licensed air storage, however, would not require monitoring for maintenance of an inert-gas environment (which IDS requires) but does require the development of allowable temperature limits below which UO_2 oxidation in breached fuel rods would not become a problem. Scoping tests at PNL with nonirradiated UO_2 pellets and spent-fuel fragment specimens identified the need for a statistically designed test matrix with test temperatures bounding anticipated maximum acceptable air-storage temperatures. This facility was designed and operated to satisfy that need. 7 refs.

14368 **(UCID—21218-Rev.1) Packaging review guide for reviewing safety analysis reports for packagings: Revision 1.** Fisher, L.E.; Chou, C.K.; Lloyd, W.R.; Mount, M.E.; Nelson, T.A.; Schwartz, M.W.; Witte, M.C. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 245p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007279/JAW.

The Department of Energy (DOE) has established procedures for obtaining certification of packagings used by DOE and its contractors for the transport of radioactive materials. The principal purpose of this document is to assure the quality and uniformity of PCS reviews and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. The Packaging Review Guide (PRG) also sets forth solutions and approaches determined to be acceptable in the past in dealing with a specific safety issue or safety-related design area. These solutions and approaches are presented in this form so that reviewers can take consistent and well-understood positions as the same safety issues arise in future cases. An applicant submitting a SARP does not have to follow the solutions or approaches presented. It is also a purpose of the PRG to make information about DOE certification policy and procedures widely available to DOE

field offices, DOE contractors, federal agencies, and interested members of the public. 77 refs., 16 figs., 15 tabs.

14369 **Data handling requirements for the AECL Random Coil (ARC) reverifiable seal used in conjunction with spent fuel containment.** Smith, M.T.; Payne, W.E. (Atomic Energy of Canada Ltd., Chalk River, Ontario (CA)); Braun-eisen, J. (Atomic Energy Control Board, Ottawa, Ontario (CA)); Self, B.G. (Sandia National Labs., Albuquerque, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 680-683(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The AECL Random Coil (ARC) seal that has been developed by Canada has been "authorized for inspection use "by the International Atomic Energy Agency (IAEA). The methods used to handle seal verification data and the lessons learned during the proof-of-principle stage and the field trial of the seal are outlined. The readout instruments and the data storage software currently used were developed by Sandia National Laboratories. The seal verification procedures and data storage techniques used during seal development are intended for use with the seal data acquired during implementation and routine use. The concept of saving the field acquired verification data and using these data for off line analysis may be applicable to other types of reverifiable seals.

14370 **Safeguards and the U.S. waste management program.** Moran, B.W. (International Technology Programs Div., Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US)); Fishbone, L.G. (Brookhaven National Lab., Upton, NY (US)); Saling, J.H. (Oak Ridge National Lab., Oak Ridge, TN (US)); Johnson, E.R. (E.R. Johnson Associates, Inc., Oakton, VA (US)); Wonder, E.F. (ERC International, Inc., Fairfax, VA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 482-486(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

Recommended activities to initiate the cost-effective implementation of nuclear materials safeguards in the U.S. Federal Waste Management System are described. Requirements for the safeguarding of spent nuclear fuel and high-level radioactive wastes in transport operations, dry storage, fuel repackaging, and final disposal in a mined geologic repository are evaluated. OPerated by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management, licensed by the U.S. Nuclear Regulatory Commission, and eligible for International Atomic Energy Agency safeguards, the Federal Waste Management system will most likely be required to meet the directives of each safeguards authority. Recommended activities include a review of the effectiveness of existing requirements for safeguarding the spent nuclear fuel and high-level radioactive wastes associated with the Federal Waste Management System, the development of pro forma safeguards plans, the evaluation of methods for the determination of the special nuclear material content of the wastes, and the assessment of potentially applicable containment and surveillance techniques.

14371 **The use of SCANS for impact studies of transportation packages.** Mok, G.C.; Witte, M.C. (Lawrence Livermore National Lab., Livermore, CA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 160-165(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper presents the results of an impact study using the computer program SCANS (Shipping Cask Analysis System), which was developed by Lawrence Livermore National Laboratory (LLNL) for the U.S. Nuclear Regulatory Commission (NRC) and the Department of Energy (DOE) for structural analysis of transportation packages of radioactive materials. The program operates on IBM PC and compatible microcomputers. It has capabilities for other analyses such as heat transfer, pressure and thermal stress analyses. However, this study uses only the impact analysis capability, which includes a quasi-static and a dynamic analysis option. It is shown that the program produces reasonable results for a wide range of impact conditions. The results are in agreement with existing information on impact analysis and phenomenon. In view of its simplicity in modelling and convenience in usage, the SCANS program can be effectively used for confirmatory analysis, preliminary design study, and quick assessment of the need for detailed impact analysis.

14372 **Modal study - Technical approach.** Fischer, L.E. (Lawrence Livermore National Lab., Livermore, CA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 140-146(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper describes the technical approach used in the Modal Study performed by the Lawrence Livermore National Laboratory to evaluate the level of safety provided during the shipment of spent fuel from nuclear power reactors. The evaluation is performed by calculating the responses of representative spent fuel casks to severe highway and railway accidents and the hypothetical accident conditions specified in 10 CFR 71. By comparing the responses it was determined that most of highway and railway accident conditions fall within the hypothetical accident conditions. For those accidents that have higher responses, the probabilities and potential radioactive exposures of the accidents are compared with those identified by the assessments made in NUREG-0170.

14373 **Overview of regulations and requirements.** Fischer, L.E.; Chou, C.K. (Lawrence Livermore National Lab., Livermore, CA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 134-139(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper provides a personal overview of current regulations and requirements for transporting radioactive materials. Three major areas are discussed. First, a brief description is presented on the need for and the development of regulations and how they relate to engineering practices and to public health and safety. Next, specific regulations and national codes and standards which affect the transport of radioactive materials are identified. Finally, the basic intent of and the adequacy of transport regulations are discussed in terms of past risk studies funded by the Nuclear Regulatory Commission.

14374 **Important features affecting thermal protection provided by drum and fiberboard packages.** Towell, R.H. (U.S. Dept. of Energy, Germantown, MO (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 174-180(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

Radioactive materials that do not require much shielding are frequently shipped inside steel drums with cane fiberboard dunnage between the containment vessel and the steel drum. The cane fiberboard serves two purposes; 1) it cushions the containment vessel from impact and puncture and 2) it thermally protects the containment vessel from fire all as defined by the hypothetical accident tests specified in 10 CFR 71.73. Cane fiberboard provides the thermal protection by two mechanisms, insulation and sacrificial decomposition. This paper discusses the more important of the two, sacrificial decomposition, the design features that are important to the thermal performance of the package and the range of acceptable variation in these features.

14375 **Graded approach for establishment of QA requirements for Type B packaging of radioactive material.** Fabian, R.R.; Woodruff, K.C. (Argonne National Lab., Argonne, IL (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 172-173(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

A study that was conducted by the Nuclear Regulatory Commission for the U.S. Congress to assess the effectiveness of quality assurance (QA) activities has demonstrated a need to modify and improve the application of QA requirements for the nuclear industry. As a result, the packaging community, along with the nuclear industry as a whole, has taken action to increase the efficacy of the QA function. The results of the study indicate that a

graded approach for establishing QA requirements is the preferred method. The essence of the graded approach is the establishment of applicable QA requirements to an extent consistent with the importance to safety of an item, component, system, or activity. This paper describes the process that is used to develop the graded approach for QA requirements pertaining to Type B packaging.

14376 **Estimated effects on radiation doses from alternatives in a spent fuel transportation system.** Schneider, K.J.; Ross, W.A.; Smith, R.I. (Pacific Northwest Lab., Richland, WA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 611-618(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper contains the results of a study of estimated radiation doses to the public and workers from the transport of spent fuel from commercial nuclear power reactors to a geologic repository. A postulated reference rail/legal-weight truck transportation system is defined that would use current transportation technology, and provide a breakdown of activities and time/distance/dose-rate estimates for each activity within the system. Collective doses are estimated for each of the major activities at the reactor site, in transit, and at the repository receiving facility. Annual individual doses to the maximally exposed individuals or groups of individuals also estimated. The dose-reduction potentials and costs are estimated for a total of 17 conceptual alternatives and subalternatives to the postulated reference system. Most of the alternatives evaluated are estimated to provide both cost and dose reductions. The major conclusion is that the potential exists for significant future reductions in radiation doses to the public and workers and for reductions in costs compared to those based on a continuation of past practices in the U.S.

0520 Waste Management

REFER ALSO TO CITATION(S) 14355, 14355, 14366, 14370, 14376, 14458, 14728, 14820, 15100, 15271, 15472, 15520, 15533, 15582, 15583, 15995, 15997, 16014

14377 **(CEA-DAS—522) French radioactive wastes performance assessment and the natural analogues approach: an overview.** Escalier des Orres, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Oct 1988. 9p. (CONF-8806184—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756653/JAW.

From International Working Group on Natural Analogs meeting; Snowbird, UT, USA (15 Jun 1988).

One of the main difficulties linked to the Radioactive Waste Performance Assessment calculations lies in the scale of time and space underlying these calculations: mechanisms and parameters can directly be affected by time or space dependency. The "natural analogues" approach has evident advantages, at least qualitative, to enlighten these aspects. It may also provide confidence in our ability to model partial or overall natural systems. The following paper gives the headlines of the use of the "natural analogues" methodology in the French Radioactive Wastes Performance Assessment in the field of waste disposal.

14378 **(CEA-DAS—537) Coupling between a geochemical model and a transport model of dissolved elements.** Jacquier, P.; Vinson, J.M.; Coudrain-Ribstein, A.; Vinsot, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire; CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (FR). Inst. de Protection et de Surete Nucleaire; Ecole Nationale Superieure des Mines de Paris, 77 - Fontainebleau (FR)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Oct 1988. 10p. (CONF-881066—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756654/JAW.

From 12. international symposium on the scientific basis for nuclear waste management; Berlin, F.R. Germany (10 Oct 1988).

In order to assess the safety analysis of an underground repository, the transport of radioelements in groundwater and their interactions with the geological medium are modelled. The objective of this work is the setting up and experimental validation of the coupling of a geochemical model with a transport model of dissolved elements. A laboratory experiment was developed at the CEA center of Cadarache. Flow-through experiments were carried out on columns filled with crushed limestone, where several inflow conditions were taken into account as the temperature, the presence of a pollutant (strontium chloride) at different concentrations. The results consist of the evolution of the chemical composition of the water at the outlet of the column. The final aim of the study is to explain these results with a coupled model where geochemical and transport phenomena are modelled in a two-step procedure. This code, called STELE, was built by introducing a geochemical code, CHIMERE, into an existing transport code, METIS. At this stage, the code CHIMERE can take into account: any chemical reaction in aqueous phase (complexation, acid-base reaction, redox equilibrium), dissolution-precipitation of minerals and solid phases, dissolution-degassing of gas. The paper intends to describe the whole process leading to the coupling which can be forecasted over the next years between geochemical and transport models.

14379 **(CEA-DAS—538) Melodie: a code for risk assessment of waste repositories in deep geological formations.** Lewi, J.; Mejon-Goula, M.J.; Cernes, A.; Goblet, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire; Ecole Nationale Superieure des Mines, 77 - Fontainebleau (FR)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Oct 1988. 10p. (CONF-881066—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756655/JAW.

From 12. international symposium on the scientific basis for nuclear waste management; Berlin, F.R. Germany (10 Oct 1988).

In order to perform the safety evaluation of nuclear waste repositories, a global model, called MELODIE, is currently developed at the CEA/IPSN, in collaboration with order CEA teams and non-CEA like ENSMP (Ecole Nationale Superieure des Mines de Paris). The version now in operation allows to assess the radiological consequences due to a repository located in a granitic formation on a period of several hundred thousands of years. The calculations are based on models which represent the physical and chemical phenomena in connection with: the release of the radionuclides from the waste matrixes and through the engineered barriers; their transfer through the geosphere; their behaviour in the biosphere. Three separate models have been developed for each of these subjects; they are integrated in the code through a modular flexible dataprocessing structure which calls these computational modules with their optimal time step and extracts the data from the data files where they are stored. In addition, a sensitivity and uncertainty analysis algorithm has been implemented into the code. It allows to evaluate the influence of the parameter values on the result and to assess the global uncertainty on it. After a quite general description of MELODIE, the calculations performed with it in the PAGIS (CCE) exercise: global dose calculations and ranking of the most important parameters through the sensitivity analysis, are presented. The studies performed only with the geosphere module of MELODIE (METIS), especially the participation to the HYDROCOIN (OECD/NEA) exercise, are also noticed. In addition, the main future development axes of MELODIE are outlined.

14380 **(DOE/LLW—72T-Vol.1) Prototype license application safety analysis report: Belowground vault: Volume 1, Safety analysis report.** (EG and G Idaho, Inc., Idaho Falls (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Oct 1988. Contract AC07-76ID01570. 392p. NTIS, PC A17/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007179/JAW.

The objective of this Safety Analysis Report (SAR) is to present the design of a Below-Ground Vault (BGV) low-level waste (LLW) disposal facility and perform an evaluation of the disposal facility to demonstrate compliance with the performance objectives and technical requirements. This SAR conforms to the guidance for a safety analysis report provided by the NRC.

14381 **(DOE/LLW—72T-Vol.2) Prototype license application project safety analysis report: Belowground vault: Volume 1, Appendices A-H.** (EG and G Idaho, Inc., Idaho Falls (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Oct 1988. Contract AC07-76ID01570. 331p. NTIS, PC A15/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007180/JAW.

The purpose of this Design Basis Document is to provide the design criteria and related information for the design of a Below-Ground Vault (BGV) disposal facility for commercial low-level radioactive waste (LLW). The BGV design shall contain information detail consistent with a conceptual design, but there will be sufficient detail that a technical safety analysis may be performed. Furthermore, the design emphasis shall be on the waste disposal features of the facility. The scope of the Design Basis Document includes: principal design criteria and related codes and standards, functional and operating requirements, and site and waste characteristics. The design and supporting information will form the basis of a technical safety analysis which shall be documented in a Prototype Safety Analysis Report (SAR). It is assumed that the disposal facility is located in the northeastern United States, on a site satisfying the technical site suitability requirements. 16 refs., 16 figs., 11 tabs.

14382 **(DOE/LLW—72T-Vol.3) Prototype license application safety analysis report: Belowground vault: Volume 3, Sensitivity analysis report.** Merrell, G.B.; Rogers, V.C. (EG and G Idaho, Inc., Idaho Falls (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Oct 1988. Contract AC07-76ID01570. 184p. (EGG-LLW—72T). NTIS, PC A09 - OSTI. Order Number DE89007181/JAW.

A radionuclide migration analysis has been performed for a hypothetical below-ground vault low-level radioactive waste disposal facility as part of a prototype safety analysis report. The sensitivity of the results to various parameters are assessed in this report. Parameters of interest for the sensitivity analysis are (a) the quantity of water percolating through the cover system, (b) the soil permeability for the uncapped portions of the site, and (c) subsurface concentrations of chemicals which affect concrete vault degradation. The water percolation rate through the cover system was varied to model the case in which the cover fails completely. The base case values for an intact cover system are 25 cm/yr for the Class A cover and 4 cm/yr for the Class B/C cover. The sensitivity analysis used a value of 45 cm/yr, which is the calculated percolation rate for the watershed. This percolation rate, when applied to the waste disposal units, leads to higher radionuclide leach rates. The greatest maximum dose is about a factor of 2.7 higher than in the base case. 4 refs., 15 tabs.

14383 **(DOE/LLW—73T-Vol.1) Prototype license application safety analysis report: Earth-mounded concrete bunker: Volume 1, Safety analysis report.** (EG and G Idaho, Inc., Idaho Falls (USA); Ebasco Services, Inc., New York (USA)). Nov 1988. Contract AC07-76ID01570. 425p. NTIS, PC A18/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007183/JAW.

The Low-Level Radioactive Waste Policy Amendment Act of 1985 (Ref. 1) requires the US Department of Energy (DOE) to provide technical assistance to the compact regions, host states and nonmember states as determined by the Secretary of Energy. Technical assistance has been defined to include alternative technologies for low-level radioactive waste (LLRW) disposal. Alternative technologies refer to concepts for the disposal of LLRW other than the traditional shallow land burial (SLB) type. Because of wide public interest in alternative technologies, we performed a study of the Earth Mounded Concrete Bunker (EMCB) concept for a LLRW disposal facility. The EMCB disposal concept is of great public interest because it represents an engineered alternative LLRW disposal method to SLB currently in use. This engineered disposal method is being practiced at Centre de la Manche, France, and is the chosen technology for the next planned disposal facility in France. The EMCB technology was developed in response to the French experience with traditional SLB. 86 refs., 21 figs., 69 tabs.

14384 **(DOE/RL—88-27-Vol.1) Grout treatment facility dangerous waste permit application.** (Westinghouse Hanford Co., Richland, WA (USA)). 23 Nov 1988. Contract AC06-87RL10930. 585p. NTIS, PC A25/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007111/JAW.

This section briefly describes the Hanford Site, provides a general description of the site operations and administration, provides an overview of the contents of this Grout Treatment Facility (GTF) Permit Application, and gives a list of acronyms and abbreviations used in the document. The decision was made to use the checklist as a locator reference instead of using the checklist section numbers as paragraph section numbers because several different types of waste management units, some of which are not addressed in the checklists, are part of the GTF. The GTF is a waste management unit within the Hanford Site facility. In May 1988, permit application was filed that identified the GTF as an existing facility. The GTF mixes dry cementitious solids with liquid mixed wastes (containing both dangerous and radioactive constituents) produced by Hanford Site operations. In addition to the design and operating features of the GTF that are intended to meet the requirements of dangerous waste regulations, many additional design and operating features are necessary to comply with radioactive waste management practices. The GTF design features and practices are intended to keep operational exposure to radionuclides and dangerous substances "as low as reasonably achievable" (ALARA) and to provide a disposal system that protects the environment for at least 10,000 yr. In some instances, ALARA practices present difficulties when complying with requirements of dangerous waste regulations.

14385 **(DOE/RL—88-27-Vol.2) Grout Treatment Facility dangerous waste permit application.** (Westinghouse Hanford Co., Richland, WA (USA)). 23 Nov 1988. Contract AC06-87RL10930. 516p. NTIS, PC A22 - OSTI. Order Number DE89007115/JAW.

This section briefly describes the Hanford Site, provides a general description of the site operations and administration, provides an overview of the contents of this Grout Treatment Facility (GTF) Permit Application, and gives a list of acronyms and abbreviations used in the document. The decision was made to use the checklist as a locator reference instead of using the checklist section numbers as paragraph section numbers because several different types of waste management units, some of which are not addressed in the checklists, are part of the GTF. The GTF is a waste management unit within the Hanford Site facility. In May 1988, a permit application was filed that identified the GTF as an existing facility. The GTF mixes dry cementitious solids with liquid wastes (containing both dangerous and radioactive constituents) produced by Hanford Site operations. In addition to the design and operating features of the GTF that are intended to meet the requirements of dangerous waste regulations, many additional design and operating features are necessary to comply with radioactive waste management practices. The GTF design features and practices are intended to keep operational exposure to radionuclides and dangerous substances "as low as reasonably achievable" (ALARA) and to provide a disposal system that protects the environment for at least 10,000 yr. In some instances, ALARA practices present difficulties when complying with requirements of dangerous waste regulations. This volume contains 14 Appendices. Topics include Engineering Drawings, Maps, Roads, Toxicity Testing, and Pilot-Scale Testing.

14386 **(DOE/RL—88-27-Vol.3) Grout treatment facility dangerous waste permit application.** (Westinghouse Hanford Co., Richland, WA (USA)). 23 Nov 1988. Contract AC06-87RL10930. 472p. NTIS, PC A20/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007112/JAW.

This section briefly describes the Hanford Site, provides a general description of the site operations and administration, provides an overview of the contents of this Grout Treatment Facility (GTF) Permit Application, and gives a list of acronyms and abbreviations used in the document. The decision was made to use the checklist as a locator reference instead of using the checklist section numbers as paragraph section numbers because several different types of waste management units, some of which are not addressed in the checklists, are part of the GTF. The GTF is a waste management unit within the Hanford Site facility. In May 1988, a permit

application was filed that identified the GTF as an existing facility. The GTF mixes dry cementitious solids with liquid mixed wastes (containing both dangerous and radioactive constitutents) produced by Hanford Site operations. In addition to the design and operating features of the GTF that are intended to meet the requirements of dangerous waste regulations, many additional design and operating features are necessary to comply with radioactive waste management practices. The GTF design features and practices are intended to keep operational exposure to radionuclides and dangerous substances "as low as reasonably achievable" (ALARA) and to provide a disposal system that protects the environment for at least 10,000 yr. In some instances, ALARA practices present difficulties when complying with requirements of dangerous waste regulations. This volume contains 2 Appendices covering engineering drawings and operating procedures.

14387 **(DOE/RL—88-27-Vol.4) Grout treatment facility dangerous waste permit application.** (Westinghouse Hanford Co., Richland, WA (USA)). 23 Nov 1988. Contract AC06-87RL10930. 525p. NTIS, PC A22/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007113/JAW.

This section briefly describes the Hanford Site, provides a general description of the site operations and administration, provides an overview of the contents of this Grout Treatment Facility (GTF) Permit Application, and gives a list of acronyms and abbreviations used in the document. The decision was made to use the checklist as a locator reference instead of using the checklist section numbers as paragraph section numbers because several different types of waste management units, some of which are not addressed in the checklists, are part of the GTF. The GTF is a waste management unit within the Hanford Site facility. In May 1988, a permit application was filed that identified the GTF as an existing facility. The GTF mixes dry cementitious solids with liquid mixed wastes (containing both dangerous and radioactive constituents) produced by Hanford Site operations. In addition to the design and operating features of the GTF that are intended to meet the requirements of dangerous waste regulations, many additional design and operating features are necessary to comply with radioactive waste management practices. The GTF design features and practices are intended to keep operational exposure to radionuclides and dangerous substances "as low as reasonably achievable" (ALARA) and to provide a disposal system that protects the environment for at least 10,000 yr. In some instances, ALARA practices present difficulties when complying with requirements of dangerous waste regulations. This volume contains 2 appendices covering engineering drawings and operating procedures.

14388 **(DOE/RL—88-27-Vol.5) Grout treatment facility dangerous waste permit application.** (Westinghouse Hanford Co., Richland, WA (USA)). 23 Nov 1988. Contract AC06-87RL10930. 237p. NTIS, PC A11 - OSTI. Order Number DE89007114/JAW.

The long-term performance of the grout disposal system for Phosphate/Sulfate Waste (PSW) was analyzed. PSW is a low-level liquid generated by activities associated with N Reactor operations. The waste will be mixed with dry solids and permanently disposed of as a cementitious grout in sub-surface concrete vaults at Hanford's 200-East Area. Two categories of scenarios were analyzed that could cause humans to be exposed to radionuclides and chemicals from the grouted waste: contaminated groundwater and direct intrusion. In the groundwater scenario, contaminants are released from the buried grout monoliths, then eventually transported via the groundwater to the Columbia River. As modeled, the contaminants are assumed to leach out of the monoliths at a constant rate over a 10,000-year period. The other category of exposure involves intruders who inadvertently contact the waste directly, either by drilling, excavating, or gardening. Long-term impacts that could result from disposal of PSW grout were expressed in terms of incremental increases of (1) chemical concentrations in the groundwater and surface waters, and (2) radiation doses. None of the calculated impacts exceeded the corresponding regulatory limits set by Washington State, Department of Energy, or the Nuclear Regulatory Commission.

14389 **(DOE-RW—88.019) Inventory for preliminary radiological assessments of low-level waste repositories.** Nancarrow, D.J. (Associated Nuclear Services, Epsom (UK)). (Department of the Environment, London (UK)). Jun 1988. 21p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705429/JAW.

In this report a low-level radioactive waste inventory is defined, making use of the latest available information, for application in preliminary assessments. Waste streams of the 1985 United Kingdom Radioactive Waste Inventory are screened according to whether they satisfy current criteria for disposal to a repository for low-level wastes. Cs-137, Pu-239 and Co-60 are selected as marker nuclides for the purpose of calculating inventories of other radionuclides of potential significance.

14390 **(DOE-RW—88.083) Biosphere database for assessments of radioactive waste disposals (edition 1).** Ashton, J.; Sumerling, T.J. (Associated Nuclear Services, Epsom (UK)). (Department of the Environment, London (UK)). Jun 1988. 56p. (ANS-R—595-13). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705072/JAW.

The organisation and scope of a database for use in biosphere modelling for assessments of radioactive waste disposals is described. The database consists of reference data values for use in screening calculations and supporting information which can be referred to when deriving values and range for use in site specific assessments studies. The reference data values currently adopted are appended to this report. The QA procedure for updating the reference data values and the programs and codes which make use of them is described.

14391 **(DOE-RW—88.084) Preliminary radiological assessments of low-level waste repositories.** Nancarrow, D.J.; Sumerling, T.J.; Ashton, J. (Associated Nuclear Services, Epsom (UK)). (Department of the Environment, London (UK)). Jun 1988. 330p. (ANS-R—689-3). NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS. Order Number DE88705073/JAW.

Preliminary assessments of the post-closure radiological impact from the disposal of low-level radioactive wastes in shallow engineered facilities at four sites are presented. This provides a framework to practice and refine a methodology that could be used, on behalf of the Department, for independent assessment of any similar proposal from Nirex. Information and methodological improvements that would be required are identified.

14392 **(DOE-RW—88.089) Treatment and packaging of waste plutonium and waste actinides for disposal.** Taylor, R.F.; McPhillimy, J.; Pacey, N.R. (UKAEA Harwell Lab. Chemical Engineering Div.; National Nuclear Corp. Ltd., Knutsford (UK)). (Department of the Environment, London (UK)). Jul 1988. 92p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705431/JAW.

The objectives of this work have been to review the current state of knowledge on the treatment and packaging of unusable or surplus plutonium and other waste actinides for disposal and to identify any gaps in data essential for the development of a preferred route. The exercise was based on published data which said the quantity currently to be disposed of was 50 tonnes in oxide form. A literature review over the period 1978 to 1988 was carried out and a computerised database specific to the exercise was created. From this it is concluded that there are no insuperable problems to the formulation of a disposal route although there is none currently proven. The preferred wasteform would be a glass or synthetic rock. The major complication lies in the fissile nature of plutonium which dictates limits to the package size and places restrictions on the production and disposal routes. Additional work necessary to permit a final decision is listed.

14393 **(DOE/RW—0188-1) Quarterly report on program cost and schedule, second quarter FY 1988.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). 1988. 34p. H. Order Number TI89007330/JAW.

This report is intended to provide a summary of the cost and schedule performance for the civilian radioactive waste management program. Performance data are presented for each of the major program elements. Also included in this report is the status of the Nuclear Waste Fund revenues and disbursements. This report includes performance data through March 1988. In December 1987, Congress passed the Nuclear Waste Policy Amendments Act of 1987 which changes the near-term activities of the program. Specifically, this Act required that the tuff site in Nevada be characterized as the only candidate at this time for the first repository and that site-specific activities at the other two first repository sites (the salt site in Texas and the basalt site in Washington) be terminated within 90 days of enactment. The Act also requires the phaseout of all second repository activities designed to evaluate the suitability of crystalline rock as a potential host rock for a repository. The new legislation impacts the contents of this report by focusing the first repository program on the activities of the tuff project and phasing out the activities for the salt, basalt and second repository projects.

14394 **(DOE/RW—0188-2) Quarterly report on program cost and schedule: Third quarter FY 1988.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). 1988. 36p. H; GPO Dep. Order Number DE89006815/JAW.

This report is intended to provide a summary of the cost and schedule performance for the civilian radioactive waste management program. Performance data are presented for each of the major program elements. Also included in this report is the status of the Nuclear Waste Fund revenues and disbursements. This report includes performance data through June 1988. In December 1987, Congress passed the Nuclear Waste Policy Amendments Act of 1987 which changed the near-term activities of the program. Specifically, this Act required that the tuff site in Nevada be characterized for the first repository and that site-specific activities at the other two first repository sites (the salt site in Texas and the basalt site in Washington) be terminated within 90 days of enactment. The Act requires the phase-out of all second repository activities designed to evaluate the suitability of crystalline rock as a potential hoist rock for a repository. The new legislation impacts the contents of this report by focusing the first repository program on the activities of the tuff project and phasing-out the activities for the salt, basalt and second repository projects.

14395 **(DOE/RW—0196) Initial version, dry cask storage study.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Aug 1988. 89p. H. Order Number TI89007326/JAW.

This report was prepared to study the use of dry cask storage for storing spent fuel at the sites of civilian nuclear reactors until a geologic repository is available. In conducting this study, whose results are to be reported to the Congress, the Secretary is to consider such factors as costs, effects on human health and the environment, and the extent to which the Nuclear Waste Fund can and should be used to provide funds for at-reactor storage. In addition, the Secretary is to consult with the Nuclear Regulatory Commission (NRC), include NRC comments in the report, and solicit the views of State and local governments and the public. The study performed in response to these requirements was based largely on data published by the NRC or included in documents issued by the DOE. Among the DOE documents are the MRS proposal to the Congress and a subsequent report, prepared to supply the Congress with additional information on the MRS facility. Because in evaluating dry storage at reactor sites it is necessary to take into account other options for meeting storage needs, this study covered all forms of at-reactor storage. 85 refs., 5 figs, 12 tabs.

14396 **(DOE/RW—0221) 1988 Bulletin compilation and index.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Feb 1989. 70p. H. Order Number TI89007053/JAW.

This document is published to provide current information about the national program for managing spent fuel and high-level radioactive waste. This document is a compilation of issues from the 1988 calendar year. A table of contents and one index have been provided to assist in finding information.

14397 **(EPRI-NP—6120) Engineering evaluation of selective ion-exchange radioactive waste processing at Susquehanna Nuclear Power Plant: Final report.** Vance, J.N. (Electric Power Research Inst., Palo Alto, CA (USA); Vance and Associates, Ruidoso, NM (USA)). Jan 1989. 38p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006852/JAW.

This final report describes the work performed of an engineering feasibility evaluation of the use and benefits of a selective ion exchange treatment process in the Susquehanna radwaste system. The evaluation addressed operability and processing capability concerns, radiological impacts of operating in the radwaste discharge mode, required hardware modifications to the radwaste and plant make-up systems, impacts on plant water quality limits and impacts on higher waste classifications. An economic analysis is also reported showing the economic benefit of the use of selective ion exchange. 1 ref., 4 figs., 13 tabs.

14398 (IA—1440, pp 178) **Influence of pH and sodium concentration on the absorption of /sup 137/Cs, /sup 90/Sr and /sup 90/Y by clinoptilolite and zeolite A.** Carmon, B.; Dyer, A.; Keir, D. (Israel Atomic Energy Commission, Tel Aviv; Salford Univ. (UK). Dept. of Chemistry and Applied Chemistry). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

14399 **(INIS-BR—1393) Wastes and temporary deposit. Temporary deposit.** Tranjan, A. (FURNAS, Rio de Janeiro, RJ (Brazil)). 1988. 1p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705507/JAW.

14400 **(INIS-BR—1406) Calculation of the inventory.** Heilbron Filho, P.F.L.; Oliveira Brandao, R. de. (Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ). Apr 1988. 23p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705518/JAW.

The theory of Point Kernel applied to a source uniformelly distributed in a cylindrical geometry was utilized to estimated the Cs-137 content of each package of radioactive waste collected. The Taylor equation was employed to calculate the build-up factor and the Green function G was adjusted by means of a least square method. The theory also takes into account factors such as aditional shielding, heterogeneity and humidity of the medium as well as associated uncertanties of the parameters envolved.

14401 (INIS-XN—149, pp 175-213) **Optimization of protection as a decision-making tool, for radioactive waste disposal.** Bragg, K. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1988. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW. (CONF-8803179—).

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

Politically-based considerations and processes including public perception and confidence appear to be the basis for real decisions affecting waste management activities such as siting, construction, operation and monitoring. Optimization of radiation protection is not a useful general tool for waste disposal decision making. Optimization of radiation protection is essentially a technical tool which can, under appropriate circumstances, provide a clear preference among major management options. The level of discrimination will be case-specific but, in general, only fairly coarse differences can be discriminated. The preferences determined by optimization of protection tend not to be related to the final choices made for disposal of radioactive wastes. Tools such as multi-attribute analysis are very useful as they provide a convenient means to rationalize the real decisions and give them some air of technical respectability. They do not, however, provide the primary basis for the decisions. Technical experts must develop an awareness of the non-technical approach to decision making an attempt to adjust their method of analyses and their presentation of

information to encourage dialogue rather than confrontation. Simple expressions of technical information will be needed and the use of analogues should prove helpful.

14402 **(LA—11504-MS) Fracture-coating minerals in the Topopah Spring Member and upper tuff of Calico Hills from drill hole J-13.** Carlos, B. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007100/JAW.

Fracture-lining minerals from drill core in the Topopah Spring Member of the Paintbrush Tuff and the tuff of Calico Hills from water well J-13 were studied to identify the differences between these minerals and those seen in drill core USW G-4. In USW G-4 the static water level (SWL) occurs below the tuff of Calico Hills, but in J-13 the water table is fairly high in the Topopah Spring Member. There are some significant differences in fracture minerals between these two holes. In USW G-4 mordenite is a common fracture-lining mineral in the Topopah Spring Member, increasing in abundance with depth. Euhedral heulandite >0.1 mm in length occurs in fractures for about 20 m above the lower vitrophyre. In J-13, where the same stratigraphic intervals are below the water table, mordenite is uncommon and euhedral heulandite is not seen. The most abundant fracture coating in the Topopah Spring Member in J-13 is drusy quartz, which is totally absent in this interval in USW G-4. Though similar in appearance, the coatings in the vitrophyre have different mineralogy in the two holes. In USW G-4 the coatings are extremely fine grained heulandite and smectite. In J-13 the coatings are fine-grained heulandite, chabazite, and alkali feldspar. Chabazite has not been identified from any other hole in the Yucca Mountain area. Fractures in the tuff of Calico Hills have similar coatings in core from both holes. In J-13, as in USW G-4, the tuff matrix of the Topopah Spring Member is welded and devitrified and that of the tuff of Calico Hills is zeolitic. 11 refs., 10 figs., 5 tabs.

14403 **(LA-UR—88-3961) Application of rock melting to construction of storage holes for nuclear waste.** Neudecker, J.W. Jr. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 3p. (CONF-890238—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003603/JAW.

From Annual meeting and exhibit of the Society of Mining Engineers, Inc.; Las Vegas, NV, USA (27 Feb 1989).

Rock melting technology can provide in-situ glass liners in nuclear waste package emplacement holes to reduce permeability and increase borehole stability. Reduction of permeability would reduce the time and probability of groundwater contacting the waste packages. Increasing the stability of the storage boreholes would enhance the retrievability of the nuclear waste packages. The rock melting hole forming technology has already been tested in volcanic tuff similar to the geology at the proposed nuclear waste repository at Yucca Mountain, Nevada. 6 refs., 5 figs., 2 tabs.

14404 **(LBL—26395) Numerical simulation of cesium and strontium migration through sodium bentonite altered by cation exchange with groundwater components.** Jacobsen. J.S.; Carnahan, C.L. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 6p. (CONF-881066—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006653/JAW.

From 12. international symposium on the scientific basis for nuclear waste management; Berlin, F.R. Germany (10 Oct 1988).

Numerical simulations have been used to investigate how spatial and temporal changes in the ion exchange properties of bentonite affect the migration of cationic fission products from high-level waste. Simulations in which fission products compete for exchange sites with ions present in groundwater diffusing into the bentonite are compared to simulations in which the exchange properties of bentonite are constant. 12 refs., 3 figs., 2 tabs.

14405 **(NSS-R—117) Measurement of effective K/sub D/ factors for the long-lived uranium and thorium isotopes in samples of London Clay (Bradwell) and mudrock (Fulbeck).** Ivanovich, M.; Longworth, G.; Wilkins, M.A.; Hasler, S.E.; Lloyd, M.J. (UKAEA Harwell Lab. Nuclear Physics Div.). (United Kingdom Nirex, Ltd., Harwell). May 1988. 35p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705391/JAW.

Measurements of the actinide isotopic activities and their activity ratios in the natural decay series provide a direct method for determining sorption parameters in field samples and give an indication of the stability of a given rock/water system. Both of these aspects are of relevance to the far-field of the radioactive waste disposal in geological formations. The distributions of /sup 238/U, /sup 234/U, and /sup 230/Th, and /sup 232/Th and /sup 228/Th radionuclides from the decay series originating with /sup 238/U and /sup 232/Th respectively, have been studied for the different liquid and solid phases in London Clay at Bradwell and mudrock at Fulbeck. The distribution coefficients (K/sub D/) and retardation factors (R) have been deduced from the radiometric data obtained by isotope dilution/alpha spectrometry techniques.

14406 **(NUREG/CR—5239) Fluid flow and solute transport modeling through three-dimensional networks of variably saturated discrete fractures.** Rasmussen, T.C.; Evans, D.D. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Arizona Univ., Tucson (USA). Dept. of Hydrology and Water Resources). Jan 1989. 193p. NTIS, PC A10/MF A01 - GPO - OSTI. Order Number TI89006382/JAW.

The boundary integral method is used to estimate hydraulic and solute transport properties of unsaturated, fractured rock by solving the boundary value problem within intersecting fracture planes. Flow through both impermeable and permeable rock is determined using two- and three-dimensional formulations, respectively. Synthetic fracture networks are created to perform sensitivity studies, results of which show that: (1) The global hydraulic conductivity is linearly dependent on the product of fracture transmissivity and density for fractures of infinite length: (2) The effect of correlation between fracture length and transmissivity is to increase the global hydraulic conductivity; and (3) Simulated flow through a fractured permeable matrix compare favorably with analytical results. Flow through variably saturated fractures is modeled using a constant capillary head within individual fractures. A simulated free surface compares favorably with an approximate analytic solution and with laboratory results. A simulated free surface compare favorably with an approximate analytic solution and with laboratory results. Simulations indicate zones of water under both positive and negative pressure, as well as regions of air-filled voids. Travel times and breakthrough curves are determined by integrating the inverse velocity over a streamline, and then summing overall streamlines. Faster travel times are noted as fracture saturation decreases for the fracture network examined. 212 refs., 58 figs., 19 tabs.

14407 **(NUREG/CR—5251) Wellfield installation and investigations, Creston Study Area, Eastern Washington.** Paschis, J.A.; Kunkel, J.R.; Koenig, R.A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; In-Situ, Inc., Laramie, WY (USA)). Nov 1988. 465p. NTIS, PC A20 - GPO - OSTI. Order Number TI89006259/JAW.

The report summarizes the design and implementation of field testing used to characterize the Roza Member basalt aquifer of the Wanapum Formation of the Columbia River Basalt Group. A research wellfield was implemented and tests conducted to lithologically classify subsurface conditions underlying an 800- by 1400-foot area located in the northwest quarter of Section 16, T.25N, R.34E, six miles south of the town of Creston in Lincoln County, Washington. The relatively high-yielding aquifers of the Roza Member basalt are separated by claystone aquitards and are hydrologically interrupted by at least two different subsurface hydrologic structures. Water-level data were used to determine the regional and local hydraulic gradient. Wellbore slug tests and passive (nonpumping) tracer tests permitted calculation of equivalent hydraulic apertures and effective porosities for the Roza basalt flow top and flow interiors. Analysis of data from pumping tests permitted calcu-

lation of transmissivities and storage coefficients for the Roza basalt. Measurements of water level are continuing, and additional tracer tests have been conducted both in the wellfield proper and in the larger study area. Applicable wellfield aquifer analyses along with model studies will provide guidelines for use in evaluating proposed sites for disposing of high-level nuclear waste in saturated fractured geologic media. 36 refs., 72 figs., 16 tabs.

14408 **(NVO—325) Nevada test site defense waste acceptance criteria, certification, and transfer requirements.** (USDOE Nevada Operations Office, Las Vegas; Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Oct 1988. Contract AC08-84NV10327. 37p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007054/JAW.

The Nevada Test Site (NTS) Defense Waste Acceptance Criteria, Certification, and Transfer Requirements establishes procedures and criteria for safe transfer, disposal, and storage of defense transuranic, low-level, and mixed waste at the NTS. Included are an overview of the NTS defense waste management program; the NTS waste acceptance criteria for transuranic, low-level, and mixed wastes; waste certification requirements and guidance; application to submit waste; and requirements for waste transfer and receipt. 5 figs.

14409 **(ORNL/TM—10981) The Sedimentary Rock Program: A summary of the geochemical characteristics of shale important to waste isolation.** Jacobs, G.K. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006806/JAW.

The geochemical characteristics of shales were investigated to evaluate their potential to serve as host media for the isolation of radioactive wastes. Four end-member shales for investigation were selected to represent smectite-rich, illite-rich, carbonate-rich, and organic-rich shales. The mineralogical differences between these shales were characterized and used to assess the potential behavior of these types of shales. The compositions of groundwaters associated with various shale terrains were obtained through a search of the literature and data bases. The ranges in groundwater composition can be summarized as follows: pH = 5.9-10.9, Na = 1.8-73,025 mg/L, Ca = 0. 7-2000 mg/L, mg = 0.2-559 mg/L, K = 0.2-349 mg/L, Cl = 0.5-120,008 mg/L, SO_4 = 0.2-5395 mg/L, and SiO_2 = 0.2-43 mg/L. Rock-water experiments and reaction path modeling were used to help interpret these results and perform sensitivity calculations. Sorption tests using Cs, Sr, U, Np, and Tc indicate that the shales have moderate to high affinity for ion-exchangeable cations. The behavior of redox-sensitive elements was somewhat more complicated, but mild sorption is suggested and may be related to the organic matter present in the shales, although the data do not support firm conclusions. 47 refs., 3 figs., 7 tabs.

14410 **(PNL—6379) DWPF [Defense Waste Processing Facility] canister impact testing and analyses for the Transportation Technology Center.** Farnsworth, R.K.; Mishima, J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 43p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006564/JAW.

A legal weight truck cask design has been developed for the US Department of Energy by GA Technologies, Inc. The cask will be used to transport defense high-level waste canisters produced by the Defense Waste Processing Facility (DWPF) at the Savannah River Plant. The development of the cask required the collection of impact data for the DWPF canisters. The Materials Characterization Center (MCC) performed this work under the guidance of the Transportation Technology Center (TTC) at Sandia National Laboratories. Two full-scale DWPF canisters filled with nonradioactive borosilicate glass were impacted under "normal" and "hypothetical" accident conditions. Two canisters, supplied by the DWPF, were tested. Each canister was vertically dropped on the bottom end from a height of either 0.3 m or 9.1 m (for normal or hypothetical accident conditions, respectively). The structural integrity of each canister was then examined using helium leak and dye penetrant testing. The canisters' diameters and heights, which had been previously measured, were then remeasured to determine how the canister dimensions had changed. Following structural integrity testing, the canisters were flaw leak tested. For transportation flaw leak testing, four holes were fabricated into the shell of canister A-27 (0.3 m drop height). The canister was then transported a total distance of 2069 miles. During transport, the waste form material that fell from each flaw was collected to determine the amount of size distribution of each flaw release. 2 refs., 8 figs., 12 tabs.

14411 **(PNL—6770) MRS Action Plan Task B report: Analyses of alternative designs and operating approaches for a Monitored Retrievable Storage Facility.** Woods, W.D.; Jowdy, A.K.; Keehn, C.H.; Gale, R.M.; Smith, R.I. (Pacific Northwest Lab., Richland, WA (USA); Parsons (Ralph M.) Co., Pasadena, CA (USA)). Dec 1988. Contract AC06-76RL01830;AC06-84RL10436. 646p. NTIS, PC A99 - OSTI. Order Number DE89006403/JAW.

The Nuclear Waste Policy Amendments Act (NWPAA) instituted a number of changes in the DOE commercial nuclear waste management system. After passage of the Act, the DOE initiated a number of systems studies to reevaluate the role of Monitored Retrievable Storage (MRS) within the federal waste management system. This report summarizes the results of a study to determine the schedules and costs of developing those MRS facilities needed under a number of scenarios, with differing functions allocated to the MRS and/or different spent fuel acceptance schedules. Nine cases were defined for the system study, seven of which included an MRS Facility. The study cases or scenarios evaluated varied relative to the specific functions to be performed at the MRS. The scenarios ranged in magnitude from storage and shipment of bare, intact spent fuel to consolidating the spent fuel into repository emplacement containers prior to storage and shipment. Each scenario required specific modifications to be made to the design developed for the MRS proposal to Congress (the Conceptual Design Report). 41 figs., 326 tabs.

14412 **(PNL-SA—16440) Radiation dose calculations for inadvertent intruders.** Napier, B.A.; Kennedy, W.E. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 4p. (CONF-8811141—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004353/JAW.

From Host States Technical Coordinating Committee meeting; El Paso, TX, USA (29 Nov 1988).

For low-level radioactive wastes disposed of near the surface of the earth, the possibility exists that at some future time a person or persons could inadvertently contact the wastes and receive a radiation dose as a result. This possibility has been recognized by numerous organizations and forms part of the basis for waste disposal regulations. This paper reviews the many types of intruder scenarios that have been proposed by various agencies, along with the parameters that are important to them. The uses of the various scenarios are illustrated. The applications of recently evolving uncertainty techniques are emphasized. The possibility that people could accidentally come in contact with buried wastes at some time in the future has led to several considerations in waste management. Regulations state that design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed. Site suitability requirements, specifically those for low population density and absence of valuable resources, are based on minimizing the potential for human intrusion. The requirements for waste form classification and the extent of cover and barrier requirements for Class C waste are designed to minimize the dose to inadvertent intruders. 8 refs.

14413 **(PNL/SRP—6681) HYDROCOIN [hydrologic code intercomparison] Level 1: Benchmarking and verification test results with CFEST [Coupled Fluid, Energy, and Solute Transport] code.** Yabusaki, S.B.; Cole, C.R.; Holford, D.J.; Monti, A.M.; Gupta, S.K. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 97p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007056/JAW.

The US Department of Energy (DOE) participated in the international hydrologic code intercomparison (HYDROCOIN) project organized by the Swedish Nuclear Power Inspectorate for

the purpose of improving our knowledge about the influence of various strategies for ground-water flow modeling for the safety assessment of final repositories for nuclear waste. The HYDROCOIN project consisted of three levels of effort: (1) Level 1 was concerned with verifying the numerical accuracy of the code, (2) Level 2 was involved with validation of models using field experiments, and (3) Level 3 was concerned with sensitivity and uncertainty analysis. In the HYDROCOIN Level 1 effort, seven cases were defined. The definition of each case included the input parameters, governing equations, output specifications, and format. The Coupled Fluid, Energy, and Solute Transport (CFEST) code was applied to solve Cases 1, 2, 4, 5, and 7; the Finite-Element Three-Dimensional Ground-Water (FE3DGW) Flow Model was used to solve Case 6. Case 3 was ignored because unsaturated flow was not pertinent to the Salt Repository Project. This report presents the Level 1 results furnished by the project teams. The numerical accuracy of the codes is determined by: (1) comparing the computational results with analytical solutions for cases that have analytical solutions (Cases 1 and 4), and (2) intercomparing results from codes for cases that do not have analytical solutions (Cases 2, 5, 6, and 7). Cases 1, 2, 6, and 7 relate to flow analyses, whereas Cases 4 and 5 require nonlinear solutions. 7 refs., 71 figs., 10 tabs.

14414 **(PNL/SRP—6682) Hydrocoin Level 3 Case I: Sensitivity and uncertainty analyses of saturated, two-dimensional flow through a shallow-land disposal facility in an argillaceous medium.** Holford, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 73p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007055/JAW.

Sensitivity and uncertainty analyses were conducted for simulated groundwater flow at a hypothetical, shallow-land disposal facility where low- and intermediate-level radioactive waste is disposed of in an argillaceous medium (horizontally bedded clay) that overlies an aquifer. First, several different scenarios (conceptual models) were developed to observe their effect on the performance measures. Next, the uncertainty analysis used a statistical sampling method with Latin Hypercube Sampling. Finally, three different methods of sensitivity analysis were compared: a statistical sampling/multiple regression method using a first-order regression model, a second-order regression model, and a deterministic method. The hydraulic conductivity of the aquifer, the hydraulic conductivity of the clay immediately surrounding the waste repository, and the anisotropy ratio of the vertical to horizontal hydraulic conductivities of the clay and aquifer proved to be the variables that contributed most to uncertainty in model output. The first-order regression model, which is commonly used in sensitivity analyses of this type, did not provide an accurate assessment of system sensitivity. The second-order regression model was valid, and predicted global (average) sensitivities that were quite different from the local sensitivities predicted by the deterministic method, indicating the importance of interactions between the input variables of the model. 6 refs., 76 figs., 15 tabs.

14415 (SAAS—360, pp 2-11) **Tasks of radiation protection in the centralized collection and ultimate disposal of radioactive waste.** Boerst, F.M.; Fasten, C.; Koerner, W.; Oppermann, U.; Werner, H.J.; Zappe, D. 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780051/JAW. (CONF-830523—).

From International conference on radioactive waste management; Seattle, WA, USA (16 May 1983).

In the GDR, the ERAM (Endlager fuer radioaktive Abfaelle, Morsleben), an operating unit of Volkseigenes Kombinat Kernkraftwerke 'Bruno Leuschner' in Greifswald, is responsible for the central collection and ultimate disposal of radioactive waste. From the licensing body's point of view an assessment is given of the legislation for radioactive wastes, especially as to their collection, transport to and handling in the final repository. As a result, some conclusions are drawn concerning future work in this field. 9 tabs., 34 refs.

14416 (SAAS—360, pp 2-11) **Experience from developed and licensing an underground repository for low and intermediate level radioactive wastes.** Ebel, K.; Richter, D. (VE Kombinat Kernkraftwerke, Greifswald (German Democratic Republic); Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780051/JAW. (CONF-830523—).

From International conference on radioactive waste management; Seattle, WA, USA (16 May 1983).

Translation of IAEA-SM-289/7.

In the German Democratic Republic an abandoned salt mine was selected and reconstructed to serve as a central repository for low and intermediate level wastes from nuclear power plants and radioisotope production and application from all over the country. The decision to establish such a repository was based on safety and technical-economic studies performed in the 1960s. The repository is owned by the main waste producer, the nuclear plant utility. It was designed, constructed and commissioned during 1972-1978. The licensing steps included a site licence (1972), a construction licence (1974), a comissioning licence and a continuous operation licence (1979). The paper reviews the overall choice of the disposal option, the responsibilities in radioactive waste management, the licensing and surveillance activities, the methods for transport and disposal, and the waste acceptance criteria established for the repository.

14417 **(SAND—88-1460) Mining development test (Room D): In situ data report (March 1984-May 1988): Waste Isolation Pilot Plant (WIPP) thermal/structural interactions program.** Munson, D.E.; Jones, R.L.; Hoag, D.L.; Ball, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 86p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006807/JAW.

Data are presented from the mining development test (Room D), an experiment of opportunity that was fielded underground at the Waste Isolation pilot Plant (WIPP). The room was initially intended to provide only ventilation during construction of the planned tests; however, because it had the same dimensions as other actual test rooms, it provided an opportunity to develop mining, instrumentation, and data acquisition method at an early stage of the project. The data include selected fielding information, test configuration, instrumentation activities, and comprehensive results from a small number of extensometer and room closure gases installed in the test rooms. The test began in March 1984 and continues to the present. Data in this report cover the period from March 1984 to May 1988, and will be updated as necessary in future reports. 21 refs., 17 figs., 7 tabs.

14418 **(UCID—21308-Rev.1) Interim report on modeling sorption with EQ3/6.** Viani, B. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006261/JAW.

Reversible, equilibrium models of sorption to be incorporated into the EQ3/6 geochemical modeling package are summarized. Empirical sorption models as formulated in linear, Langmuir, and Freundlich isotherms will be developed as options to EQ3/6. This work will be done at LLNL. Options for modeling sorption using surface- complexation constructs (diffuse, constant capacitance, and triple-layer models) will also be developed. Development of the surface-complexation options will require part of the work be done under contract. 27 refs., 1 fig.

14419 **(UCID—21414) Thermal performance of a buried nuclear waste storage container storing a hybrid mix of PWR and BWR spent fuel rods.** Johnson, G.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 109p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006803/JAW.

Lawrence Livermore National Laboratory will design, model, and test nuclear waste packages for use at the Nevada Nuclear Waste Storage Repository at Yucca Mountain, Nevada. One such package would store lightly packed spent fuel rods from both

pressurized and boiling water reactors. The storage container provides the primary containment of the nuclear waste and the spent fuel rod cladding provides secondary containment. A series of transient conduction and radiation heat transfer analyses was run to determine for the first 1000 yr of storage if the temperature of the tuff at the borehole wall ever falls below 97{degree}C and whether the cladding of the stored spent fuel ever exceeds 350{degree}C. Limiting the borehole to temperatures of 97{degree}C or greater helps minimize corrosion by assuring that no condensed water collects on the container. The 350{degree}C cladding limit minimizes the possibility of creep-related failure in the spent fuel rod cladding. For a series of packages stored in a 8 x 30 m borehole grid where each package contains 10-yr-old spent fuel rods generating 4.74 kW or more, the borehole wall stays above 97{degree}C for the full 1000-yr analysis period.

14420 **(UCID—21444) Numerical modeling of the thermal and hydrological environment around a nuclear waste package using the equivalent continuum approximation: Horizontal emplacement.** Nitao, J.J. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 77p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006802/JAW.

In support of the investigations for an underground high-level nuclear waste repository at Yucca Mountain, Nevada, we have performed computer simulations of the immediate thermal and hydrological environment around a nuclear waste package. Calculations of this type will be needed for waste package design, performance assessment, and radionuclide transport analyses. Two dimensional computer simulations using a modified version of the TOUGH code were run for an idealized configuration derived from the COVE3 benchmarking effort consisting of a single spent fuel waste package with laterally periodic boundary conditions. The model domain extended downward to the water table and upward to the ground level. Fluid behavior in the rock was modeled using the equivalent continuum approximation. Runs were made with surface water influx rates at the surface set to 0.1, 0.5, and 1.0 mm/yr. A significant amount of code modification and development was needed in order to develop the capability to run these types of problems out to the long time spans required. 26 refs., 59 figs.

14421 **(UCID—21615) Guide for reviewing safety analysis reports for packaging: Review of quality assurance requirements.** Moon, D.W. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006797/JAW.

This review section describes quality assurance requirements applying to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging which are important to safety. The design effort, operation's plans, and quality assurance requirements should be integrated to achieve a system in which the independent QA program is not overly stringent and the application of QA requirements is commensurate with safety significance. The reviewer must verify that the applicant's QA section in the SARP contains package-specific QA information required by DOE Orders and federal regulations that demonstrate compliance. 8 refs.

14422 **(USGS-OFR—88-468) Water levels in periodically measured wells in the Yucca Mountain area, Nevada, 1981--1987.** Robison, J.H.; Stephens, D.M.; Luckey, R.R.; Baldwin, D.A. (Geological Survey, Denver, CO (USA)). 1988. Contract AI08-78ET44802. 136p. NTIS, PC A07/MF A01 - OSTI; GPO Dep. Order Number DE89006256/JAW.

This report presents water-level data for 28 wells that have been periodically measured in the Yucca Mountain area, Nevada. The report includes discussions of the methods used and corrections applied to obtain water-level depths and altitudes from onsite measurements. Water levels for each well are presented in tabular and graphical (hydrograph) form. The altitude of the water level in the upper part of the saturated zone is about 775 meters above sea level to the west of and along part of the crest of Yucca Mountain; along the eastern edge and southern end of Yucca Mountain, the water level is nearly horizontal and is 728 to 730 meters above sea level. The water-level data were obtained in cooperation with the US Department of Energy to help evaluate the suitability of the area for storing high-level nuclear waste. 38 refs., 3 figs., 2 tabs.

14423 **(USGS/WRI—88-4189) Triaxial-compression extraction of pore water from unsaturated tuff, Yucca Mountain, Nevada.** Yang, I.C.; Turner, A.K.; Sayre, T.M.; Montazer, P. (Geological Survey, Denver, CO (USA)). 1988. Contract AI08-78ET44802. 68p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006464/JAW.

The purpose of this experiment was to design and validate methods for extracting uncontaminated pore water from nonwelded parts of this tuff. Pore water is needed for chemical analysis to help characterize the local hydrologic system. A standard Hoek-Franklin triaxial cell was modified to create a chemically inert pore-water-extraction system. Experimentation was designed to determine the optimum stress and duration of triaxial compression for efficient extraction of uncontaminated pore water. Experimental stress paths consisted of a series of increasing stress levels. Trial axial stress levels ranged from 41 to 190 megapascals with lateral confining stresses of 34 to 69 megapascals. The duration of compression at any given stress level lasted from 10 minutes to 15 hours. A total of 40 experimental extraction trials were made. Tuff samples used in these tests were collected from drill-hole core from the Paintbrush nonwelded unit at Yucca Mountain. Pore water was extracted from tuff samples that had a water content greater than 13 percent by weight. Two stress paths have been determined to be applicable for future pore-water extraction from nonwelded tuff at Yucca Mountain. The initial water content of a sample affects the selection of an appropriate period of compression. 39 refs., 55 figs.

14424 **(WHC-SA—0039) Low-level liquid waste disposal site remediation technology development at the Hanford site.** Phillips, S.J.; Relyea, J.F. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 12p. (CONF-870859—32). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004907/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Westinghouse Hanford Company is developing technologies supporting long-term physical stabilization and isolation of liquid waste materials in underground waste disposal crib and caisson structures. Prototype equipment and methodologies are being developed to dynamically consolidate and/or inject durable materials into and proximal to these structures. To date, testing, development, and demonstration of a mobile in situ waste treatment system for site remediation of liquid waste disposal sites has been completed. Continued testing and development activities are in progress for in situ treatment of contaminated, industrial, solid low-level waste materials. Conceptual design activities have also been initiated to develop an injection system for application to low-level waste underground tank and vault remediation. 10 refs., 2 figs.

14425 **(WINCO—1062) An evaluation of neutralization for processing sodium-bearing liquid waste.** Chipman, N.A.; Engelgau, G.O.; Berreth, J.R. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Jan 1989. Contract AC07-84ID12435. 45p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006698/JAW.

This report addresses an alternative concept for potentially managing the sodium-bearing liquid waste generated at the Idaho Chemical Processing Plant from the current method of calcining a blend of sodium waste and high-level liquid waste. The concept is based on removing the radioactive components from sodium-bearing waste by neutralization and grouting the resulting low-level waste for on-site near-surface disposal. Solidifying the sodium waste as a remote-handled transuranic waste is not considered to be practical because of excessive costs and inability to dispose of the waste in a timely fashion. Although neutralization can remove most radioactive components to provide feed for a solidified low-level waste, and can reduce liquid inventories four to nine years more rapidly than the current practice of blending sodium-bearing liquid waste with first-cycle raffinite, the alternative will require major new facilities and will generate large volumes of low-level waste. Addi-

tional facility and operating costs are estimated to be at least $500 million above the current practice of blending and calcining. On-site, low-level waste disposal may be technically difficult and conflict which national and state policies. Therefore, it is recommended that the current practice of calcining a blend of sodium-bearing liquid waste and high-level liquid waste be continued to minimize overall cost and process complexities. 17 refs., 4 figs., 16 tabs.

14426 **(WVDP—89AR) West Valley Demonstration Project, West Valley, New York: Annual report.** (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Jan 1989. Contract AC07-81NE44139. 46p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007317/JAW.

Under the West Valley Demonstration Project Act, Public Law 96-368, liquid high-level radioactive waste stored at the Western New York Nuclear Services Center, West Valley, New York, that resulted from spent nuclear fuel reprocessing operations conducted between 1966 and 1972, is to be solidified in borosilicate glass and transported to a federal repository for geologic disposal. A major milestone was reached in May 1988 when the Project began reducing the volume of the liquid high-level waste. By the end of 1988, approximately 15 percent of the initial inventory had been processed into two waste streams. The decontaminated low-level liquid waste is being solidified in cement. The high-level waste stream is being stored in an underground tank pending its incorporation into borosilicate glass. Four tests of the waste glass melter system were completed. These tests confirmed equipment operability, control system reliability, and provided samples of waste glass for durability testing. In mid-1988, the Department validated an integrated cost and schedule plan for activities required to complete the production of the waste borosilicate glass. Design of the radioactive Vitrification Facility continued.

14427 **A high-performance, low-density waste assay system.** Li, T.K.; Simmonds, S.M.; Ensslin, N.; Cowder, L.R.; Sprinkle, J.K.; Parker, J.L.; Hykel, M.N.; Bourret, S.C.; Garcia, D.L.; Kresge, J. (Los Alamos National Lab., Los Alamos, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 744-749(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The authors have developed a high-performance, low-density waste assay (LDWA) system for determining uranium content in low density, low-Z waste materials within a short count time (typically, 120 s) and for detection of any uranium lumps that might exist in waste boxes. The LDWA system employs a far-field gamma-ray spectroscopy technique. The amount of /sup 235/U is determined by analyzing the 185.7-keV gamma ray from the waste box, which will be rotated during assay to smooth the spatial response. The detector is a high-resolution, high-purity germanium N-type coaxial unit. For a 120-s count time, the detection sensitivity of the LDWA is 0.03 g /sup 235/U and the precision (1σ) for a 1.7-g /sup 235/U sample is 4.0%. The assay accuracy arising from the effect of the vertical position of uranium is $<10\%$. For detection of any lumps of uranium that might exist in waste boxes, they have investigated the first application of enhanced alpha-particle-induced uranium x rays as a flag and demonstrated that they are increased dramatically as functions of mass and density of the uranium lumps.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 14355, 14376, 14378, 14380, 14381, 14382, 14383, 14384, 14385, 14386, 14387, 14388, 14397, 14402, 14403, 14404, 14407, 14409, 14410, 14411, 14412, 14413, 14414, 14417, 14418, 14419, 14420, 14421, 14422, 14423, 14424, 14425

14428 **Analysis of radiological survey data to determine contaminated waste volumes.** Yu, C. (Energy and Environmental Systems Div., Argonne National Lab., Argonne, IL (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 828-833(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

A procedure was developed to analyze radiological survey data from a contaminated site to determine the volume of contaminated material that has to be cleaned up or removed before the site can be released for unrestricted use. This procedure was coded in a FORTRAN computer program, RADVOL. The survey data are analyzed statistically by averaging over an area of 100 m/sup 2/ and a depth of 0.15 m; the $K\sigma$ error is used to calculate the net count rate, where K depends on the confidence level required. The net count rates are converted to radionuclide concentrations and compared with the residual radioactive material guidelines to determine if the block (100 m/sup 2/ x 0.15 m volume) is contaminated (above guidelines). The analytical results are plotted three-dimensionally, which perspectively illustrates the contamination level of each block. This procedure was tested by using radiological survey data from an actual site contaminated with radium. The results indicate that this procedure is easy to use and can be applied to those sites where radiological survey data are available. The uncertainties in the procedure are also discussed.

0540 Health And Safety

REFER ALSO TO CITATION(S) 14357, 14376, 14379, 14415, 14424

14429 (IA—1440, pp 267-268) **Control of the use of radioactive materials in Israel in 1987.** Keren, Y.; Rosenthal, N.; Surkes, M.; Tal, A.; Malchi, S.; Schlesinger, T.; Israeli, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 14369, 14370, 14371, 14372, 14373, 14375, 14428, 14755, 15621, 15627, 15633

14430 **(GAO/NSIAD—88-119FS) Nuclear materials.** (General Accounting Office, Washington, DC (USA). National Security and International Affairs Div.). 1988. 6p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

According to Section 604 of the Omnibus Diplomatic Security and Antiterrorism Act of 1986, certain agencies are required to review and report on the adequacy of physical security standards for the shipment and storage of amounts of plutonium and enriched uranium outside the United States. The reports were to be provided to the Congress within 6 months of the act's becoming law. Four out of five reports were submitted late because of disagreements between the Department of Defense and the other reporting agencies. Also, the respective reports represented each agency's views and no agency was forced to make unacceptable substantive changes. Lack of documentation prevented GAO from determining the nature and source of changes made to each agency's draft report.

14431 **(IAEA-INFCIRC—358) Text of the agreement of 29 February 1988 between Nigeria and the Agency for the application of safeguards in connection with the treaty on the non-proliferation of nuclear weapons.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 35p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705324/JAW.

The document reproduces the text of the Agreement of 29 February 1988 and of the Protocol thereto, between the Federal Republic of Nigeria and the Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons. It contains two parts. The first part stipulates the agreement of Nigeria to accept safeguards on all sources or special fissionable material in all peaceful nuclear activities within its territory, under its jurisdiction or carried out under its control anywhere for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices. The second part specifies the procedures to be applied in the implementation of the safeguards provisions of Part I. The Agreement and the Protocol entered into force on 29 February 1988.

14432 **(IAEA-INFCIRC—359) Text of the agreement of 1 July 1986 between Albania and the Agency for the application of safeguards to all nuclear activities of Albania.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 34p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705325/JAW.

The document reproduces the text of the Agreement of 1 July 1986 between the People's Socialist Republic of Albania and the Agency for the application of safeguards to all nuclear activities of Albania. It contains two parts. The first part stipulates the agreement of Albania to accept safeguards on all nuclear material or facilities within its territory, or under its jurisdiction or control anywhere for the purpose of verifying that such material is not used for the manufacture of any nuclear weapon or to further any other military purpose or for the manufacture of any other nuclear explosive device. The second part specifies the procedures to be applied in the implementation of the safeguards provisions of Part I. The Agreement entered into force on 25 March 1988.

14433 **(NUREG—1100-Vol.5) Budget estimates: Fiscal years, 1990--1991.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Jan 1989. 152p. NTIS, PC A08/MF A01 - GPO - OSTI. Order Number TI89005725/JAW.

The budget estimates for the NRC for fiscal year 1990 provide for obligations of $475,000,000, to be funded in total by two new appropriations---one is NRC's Salaries and Expenses appropriation for $472,100,000 and the other is NRC's Office of the Inspector General appropriation of $2,900,000. Of the funds appropriated to the NRC's Salaries and Expenses, $23,195,000 shall be derived from the Nuclear Waste Fund. The sum appropriated to the NRC's Salaries and Expenses shall be reduced by the amount of revenues received during fiscal year 1990 from licensing fees, inspection services, other services and collections, and from the Nuclear Waste Fund, excluding those moneys received for the cooperative nuclear safety research program, services rendered to foreign governments and international organizations, and the material and information access authorization programs, so as to result in a final fiscal year 1990 appropriation estimated at not more than $292,155,000.

14434 **(NUREG/CR—4604) Statistical methods for nuclear material management.** Bowen W.M.; Bennett, C.A. (eds.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 1000p. (PNL—5849). NTIS, PC A99/MF A01 - GPO - OSTI. Order Number TI89007032/JAW.

This book is intended as a reference manual of statistical methodology for nuclear material management practitioners. It describes statistical methods currently or potentially important in nuclear material management, explains the choice of methods for specific applications, and provides examples of practical applications to nuclear material management problems. Together with the accompanying training manual, which contains fully worked out problems keyed to each chapter, this book can also be used as a textbook for courses in statistical methods for nuclear material management. It should provide increased understanding and guidance to help improve the application of statistical methods to nuclear material management problems.

14435 **(SRDP-R—135) Precision and accuracy of the determination of uranium by controlled-potential coulometry.** Firkin, S.J. (UKAEA Harwell Lab. Chemistry Div.). (UKAEA Harwell Lab. Safeguards R and D Project). Apr 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705594/JAW.

Improvements in the solution handling and the introduction of new computer controlled coulometers developed at Harwell have resulted in an improvement in the precision of the uranium coulometric method. Results obtained using NBS 960 and EC-101 uranium reference materials over a period of several months have shown that a precision of +- 0.060% (RSD) can be obtained and that the accuracy is within the precision limits of the method. The importance of chemically calibrating the coulometric equipment with reference materials, rather than relying on the electrical calibration of the coulometer itself, is demonstrated.

14436 **(SRDP-R—139) Preparation and characterisation of a 1:1:1 mixture of /sup 239/Pu:/sup 240/Pu:/sup 242/Pu for use as a reference material for mass spectrometric analysis.** Crossley, D.; Foster, E.; Wood, A.J. (UKAEA Harwell Lab. Chemistry Div.). (UKAEA Harwell Lab. Safeguards R and D Project). Jun 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705595/JAW.

A plutonium nitrate solution containing the isotopes /sup 239/Pu, /sup 240/Pu and /sup 242/Pu in a 1:1:1 atomic ratio has been produced at Harwell for use as a reference material for thermal ionisation mass spectrometric analysis. This reference material was prepared by blending weighed quantities of stock solutions of plutonium of high isotopic enrichment and accurately known plutonium concentration, established by controlled-potential coulometric measurement. The calculated atom ratios together with the associated uncertainties at the 95% confidence level are /sup 240/Pu to /sup 239/Pu 0.9999 +- 0.0006 and /sup 242/Pu to /sup 239/Pu 0.9999 +- 0.0010.

14437 **(SRDP-R—145) Characterisation of a 1.5 weight % gallium in plutonium alloy for use as a reference material for plutonium mass analysis.** Crossley, D.; Phillips, G. (UKAEA Harwell Lab. Chemistry Div.). (UKAEA Harwell Lab. Safeguards R and D Project). Jun 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705596/JAW.

This report describes the analytical work carried out at AERE Harwell on a trial casting of 1.5% gallium in plutonium alloy intended for use as a day-to-day reference material in laboratories concerned with plutonium analysis. The plutonium metal from which the alloy was prepared was not specially purified and the alloy contains about 4000 ppm of impurities excluding the alloying element. The major impurities are americium, uranium, neptunium, carbon and oxygen. The recommended plutonium content based upon the deduction of the alloying element plus impurities from 100% is 98.075 +- 0.017 wt % (95% CI). This figure for the plutonium content is supported by controlled-potential coulometry measurements, which gave a value of 98.089 +- 0.076 wt % (95% CI), traceable to the internationally accepted reference material EC201 (plutonium metal). The alloy has been subdivided into specimens weighing about 1.7g sealed individually in quartz ampoules in a low pressure argon atmosphere.

14438 **Literature survey.** Pillay, K.K.S. (Los Alamos National Lab., Los Alamos, NM (US));. *JNMM;* **16**: No. 4, 33-36(Jul 1988).

The residential amount(s) of fissionable materials remaining in process equipment after the runout of bulk materials processed is referred to as "Process Holdup of Special Nuclear Materials." Locating regions of holdup and estimating the quantity of fissile materials remaining as holdup are important not only to materials accountability but also to process safety. Holdup is often referred to as a "Hidden Inventory." In materials accounting terminology, hidden inventories are part of "Materials Unaccounted For" (MUF) or "Inventory Difference" (ID). MUF or ID could be construed as "Loss" or "Diversion". From a safeguards perspective, all these designations are undesirable. Another terminology that is relevant to holdup is "In-Process Inventory." During process operations and temporary shutdown, the holdup within the facility is also known as the in-process inventory. Estimating this inventory is just as challenging as residuals after process runout. The role of hidden inventories, or holdup, as a safeguards problem is now recognized by almost everyone interested in establishing effective safeguards for special nuclear materials. As part of this effort to organize the first INMM-sponsored Technical Workshop on Process Holdup of Special Nuclear Materials, an attempt was made to update an earlier survey of open literature publications of relevance to holdup. An attempt was made to exclude from this list those document- recognized as internal documents, progress reports, preliminary reports, abstracts, etc.

14439 **Holdup - related issues in safeguarding of nuclear materials.** Pillay, K.K.S. (Los Alamos National Lab., Los Alamos, NM (US));. *JNMM;* **16**: No. 4, 18-20(Jul 1988).

Residual inventories of special nuclear materials (SNM) remaining in processing facilities (holdup) are recognized as an insidious problem for both safety and safeguards. This paper identifies some of the issues that are of concern to the safeguards community at-large that are related to holdup of SNM in large-scale process equipment. These issues range from basic technologies of SNM production to changing regulatory requirements to meet the needs of safeguarding nuclear materials. Although there are no magic formulas to resolve these issues, there are several initiatives that could be taken in areas of facility design, plant operation, personnel training, SNM monitoring, and regulatory guidelines to minimize the problems of holdup and thereby improve both safety and safeguards at nuclear material processing plants.

14440 **An overview of holdup measurement technology.** Zucker, M.S. (Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY (US));. *JNMM;* **16**: No. 4, 21-25(Jul 1988).

The origin of holdup, where it occurs in plants, and the methods of assay thus far found useful under conditions often found in nuclear fuel manufacturing installations are discussed. "Holdup" refers to special nuclear material (SNM) unintentionally deposited in or on process equipment or plant structure. Monitoring and assay of holdup is necessary for criticality control, calculating material balances, to gauge manufacturing efficiency, and to protect the environment, as well as for safeguards. Aside from answering the basic question of how much material is held up and where it is located, the purpose of holdup assay may also be to determine the ease or difficulty of recovery. This information can have an appreciable financial impact on the facility, either because of the intrinsic value of the material, or because of the extent of security required for a decommissioned plant. Holdup arises through imperfections in the manufacturing process, accidents or failures of equipment, and deficiencies in plant and process equipment design. Since nuclear fuel manufacturing involves finely divided powders, reactive liquid and gaseous chemicals, and grinding and sintering processes, the generation of holdup in plant and process equipment is inevitable, and assaying for it, and recovery where practical, has to be considered a part of the normal manufacturing process.

14441 **NUMATH.** Krichinsky, A.M. (Oak Ridge National Lab., Oak Ridge, TN (US));. *JNMM;* **16**: No. 4, 30-32(Jul 1988).

NUMATH is a computer program which provides near-real-time estimations of material compositions and inventories from previous inventory measurements, operating data, and available on-line process measurements - in a manner that is transparent to the computer terminal operator. In steady-state simulated-run testing, NUMATH produced estimates within 10% of the measured inventories for accountable materials.

14442 **Selected results for measuring holdup in oxide hoods and transfer lines at Hanford.** Jones, R.A.; Kerns, R.E. (Westinghouse Hanford Co., Richland, WA (US));. *JNMM;* **16**: No. 4, 6-8(Jul 1988).

Physical inventories require quantifying the holdup in process equipment; one practical way of accomplishing this is measuring the gamma ray from plutonium (/sup 239/Pu). Field measurements of plutonium holdup in dry plutonium oxide hoods or process transfer lines is frequently biased low, due to the possibility of heavy loading causing severe self-attenuation of the gamma rays. An experiment was performed to determine the allowable loading limits for measuring plutonium holdup in dry oxide hoods. Field measurements of transfer lines in a plutonium production facility are frequently biased low due to the self shielding of the holdup material. Fixed and portable gamma ray measurements were made of 6-ft-long sections of pipe. The results of this comparison are being used as a correction factor for routine field measurements of piping in the production facility.

14443 **Measurement campaigns for holdup estimation.** Picard, R.R. (Los Alamos National Lab., Los Alamos, NM (US));. *JNMM;* **16**: No. 4, 9-11(Jul 1988).

The derivation of technically defensible holdup estimates is described. Considerations important in the planning of measurement campaigns to provide necessary data are reviewed and the role of statistical sampling is discussed. By design, the presentation is nonmathematical and intended for a general audience. Though clearly important, use of sampling principles in the planning of holdup-related activities is sometimes viewed with apprehension. Holdup is often poorly understood to begin with, and the incorporation of the esoteric matters only adds to an image problem. Unfortunately, there are no painless options. In many operating facilities, surface areas on which holdup has accumulated amount to many square miles. It is not practical to pursue 100% measurement of all such surface areas. Thus, some portion is measured - constituting a "sample," whether obtained by a formal procedure or not. Understanding the principles behind sampling is important in planning and in developing legitimate holdup estimates. Although derivation of legitimate, facility-wide holdup estimates is not currently mandated by Department of Energy regulatory requirements, the related activities would greatly advance the present state of knowledge.

14444 **The importance of understanding process holdup. A Department of Energy (DOE) view.** Hammond, G.A. (U.S. Dept. of Energy, Washington, DC (US)); Hawkins, R.L. (Lamb Associates Inc., a subcontractor to Meridian Corp., Rockville, MD (US));. *JNMM;* **16**: No. 4, 12-14(Jul 1988).

Residual material in processing equipment is today and will in the future continue to be one of the major problems in controlling and accounting for nuclear material. Existing facilities were designed for product quantity, quality, and safety; not for minimization and quantification of residual material in process. With the development of measurement systems, and with enhanced material control and accounting practices and procedures, inventory differences have been emphasized. The improvement in processing input and output measurements has highlighted the problems of quantifying residual process material. The primary purpose for quantifying material held up in process is to determine the inventory difference and its related uncertainties or statistical variances. This qualification and its associated problems must be addressed if we are to prevent, deter, and detect theft and/or diversion of nuclear materials.

14445 **Safeguards training at Pacific Northwest Laboratory.** Dickman, D.A. (Pacific Northwest Lab., Richland, WA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 806-808(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

In recent years considerable attention has been given to upgrading security education programs at facilities across the country. At Pacific Northwest Laboratory (PNL), a Laboratory-wide Safeguard Awareness Training Program has been established in order to raise the cognizance of the entire staff with regard to safeguards issues and concerns. This aggressive safeguards program involves a strong interface of physical security measure and material control and accountability systems. Within PNL, four distinct audiences were defined and a needs assessment analysis performed for each to determine specific training requirements. The target audiences identified were: material balance area (MBA) custodians, managers of material balance areas, material handlers, and new employees. Five safeguards training courses were created to meet the needs of those audiences. This paper discusses the development of the Safeguards Awareness Program at PNL and its benefits to the Laboratory.

14446 **Ultrasonic seal program for MOX fuel assembly safeguards.** Cuypers, M.; D'Agraives, B.C.; Toornvliet, J. (Sandia National Labs., Albuquerque, NM (IT)); Mangan, D.L.; McKenzie, J.M.; Self, B.G.; Walter, J.W. (Sandia National Labs., Albuquerque, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 684-689(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

At the suggestion of the International Atomic Energy Agency, the Joint Research Centre, Ispra, and Sandia National Laboratories, Albuquerque, undertook a study directed at developing ultrasonic seals for international safeguards use on fuel assemblies containing mixed oxide (MOX) fuel. This joint venture has its

genesis from the previous work the two laboratories have pursued in the area of ultrasonic seals, most notably the successful demonstration of such seals on BWR Fuel Assemblies in the Kahl Reactor, FRG. From that demonstration, it was recognized that the VAK III seal of JRC is an excellent design, and that the Seal Pattern Reader (SPAR) of Sandia is the preferred approach to reading ultrasonic seals. In this program, those two aspects of ultrasonic seal technology are joined with the focus being on the sealing of PWR assemblies. This paper discusses the origin of this program, highlights the progress that has been made to date, and outlines the future activities.

14447 **Automated methods for real-time analysis of spent-fuel measurement data.** Bosler, G.E.; Rinard, P.M.; Klosterbuer, S.F.; Painter, J. (Los Alamos National Lab., Los Alamos, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 487-493(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

Software has been developed for "real-time" analysis of neutron and gamma data from GRAND-1/fork measurements on spent-fuel assemblies. Three modules compose the software package. The modules are linked through a database system of files. The first module is part of a general data-base processing code. This module prepares input data files with inventory and correction-factor information for the second module. The second module, called OLAF, operates on a computer attached to the GRAND-1 electronics unit. In this second module, neutron and gamma data from spent-fuel assemblies are analyzed to verify consistency in the facility operator declarations for exposure (burnup) and cooling time. From the analysis, potential discrepancies in the measurement data are questioned while equipment is still installed at the facility and is available for additional measurements. During the measurements, data are written to an output file, called a results file, which can be processed by the third module of the software package. In the third module, printed reports summarizing the data and results are prepared, and neutron and gamma data are written to files that are process by the Deming curve-fitting code.

14448 **Safeguards applied to the design of recovery processing.** Hawke, A.C. (Rockwell International - Rocky Flats Plant, Golden, CO (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 253-256(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

A project to redesign and modify portions of the Rocky Flats plutonium reprocessing facility is currently underway. Essential to the project is a design concept using modular construction methods to allow actual processing to occur concomitant with ongoing process operations. Although the design concept must be and is responsive to numerous Department of Energy and Rockwell requirements governing the design and operation of plutonium process systems, the purpose of this paper is to singularly focus on and review those safeguards requirements, concerns, and criteria which must be addressed in recovery processing design to ensure the protection and accountability of Special Nuclear Materials.

14449 **Tools in our chest - The computer as part of the materials control and accounting system at the operations office level.** Williams, T. (Savannah River Operations Office, Aiken, SC (US)); Hodge, C. (Science Applications International, Savannah River Plant, Aiken, SC (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 301-304(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The computer as part of a safeguards information system at the Savannah River Operations Office is discussed. The use of decision analysis software to assign ratings to surveys is explored. The design and structure of the survey tracking and inventory difference databases are analyzed. Examples of how these tools are used to solve problems and provide guidance to the Materials Control and Accounting (MC and A) program are given. Future direction and needs are outlined.

14450 **How much quality assurance.** Beatty, R.A.; Talboy, J.H. (Argonne National Lab., Argonne, IL (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 409-412(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The Argonne-Illinois quality assurance program is based on a consensus of the process we all use to achieve quality. The process for achieving quality is identifying the risks that an activity runs of not being successful, and selecting practices that eliminate the risks; in a word, determining how much quality assurance is enough. The authors will describe the approach to quality assurance that is nearly completely implemented and functioning at Argonne. They discuss the human factors built in to sustain the process and explain how those accountable for fostering quality assurance support those who are asked to apply the process.

14451 **Route selection for the transport of hazardous materials.** Seiler, F.A. (Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, P.O. Box 5890, Albuquerque, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 322-327(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The factors governing the risk-weighted selection of routes for the transport of hazardous materials are analyzed. Starting from a formulation for the total risk of these transports assuming complete information, approximations for the more realistic case of partial and uncertain information are discussed. These approximations involve well-known risk assessment techniques and mathematical methods; among the latter, Monte Carlo calculations hold the most promise. The actual route selection is based on an index of total societal cost, evaluated for a set of potential routes.

14452 **Shipments/receipts resolution program.** Davis, F.B. (E.I. Du Pont de Nemours and Co., Savannah River Plant, Aiken, SC (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 821-823(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

Savannah River Plant (SRP) has initiated an aggressive program aimed at improving shipper/receiver (S/R) posture. The site is routinely involved in 800 nuclear material transfers/year. This many transactions between facilities provides many opportunities for resolving S/R differences. Resolution of S/R differences requires considerable effort from both DOE offices and contractors, presents legitimate safeguards concerns if the receiving quantity is less than the quantity shipped, and must be resolved for shipments to continue. This paper discusses the programs in place at SRP to resolve S/R differences. S/R agreements provide a method of communicating between the shipping and receiving facilities and protect both facilities by eliminating misunderstandings. Nondestructive assay (NDA) instrumentation allows the facility to obtain an accountability quality value for receipt before the material is processed. More accurate and precise analytical techniques are in use wherever SRP does not have the capability to measure a shipment or receipt by NDA. S/R values are graphed to identify trends and/or biases that may not have exceeded any error limits. The central Material Control and Accountability (MC&A) division has become more involved in analyzing the data from shipments and receipts including the calculation of limits of error (LOE's), instrument biases, and analyzing trends.

14453 **DOE survey program order.** Kelley, H.W. (DOE Chicago Operations Office, Argonne, IL (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 468-470(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

Background information on the revision of the Department of Energy's (DOE) Safeguards and Security Orders is provided in the Panel Chairman's paper. The Survey Subtask Group's effort focused on elimination of policy gaps in the current survey program orders, as identified in the development of DOE's Safeguards and

Security Standards and Criteria, and an examination of the completeness and effectiveness of current policy where questions or issues may have arisen. The Survey Subtask Group identified the following four major areas for change: (1) the need to standardized general survey requirements, ratings and follow-up procedures for security and nuclear materials, (2) the need to incorporate standards set forth in the DOE Standards and Criteria where appropriate, (3) the need to continue to address the detailed requirements of security surveys and nuclear materials (MC&A) surveys separately, and (4) the need to include compliance based on performance-based segments. The revised Survey Order addressed the sited needs with no significant operational or cost impacts. The Subtask Group's efforts benefited from the earlier work of the Office of Safeguards and Security and various DOE Standards and Criteria and Operations Cerberus Committees.

14454 **Techniques for developing reliable and functional materials control and accounting software.** Barlich, G. (Safeguards Systems Group, Los Alamos National Lab., Los Alamos, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 312-314(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The media has increasingly focused on failures of computer systems resulting in financial, material, and other losses and on systems failing to function as advertised. Unfortunately, such failures with equally disturbing losses are possible in computer systems providing materials control and accounting (MC&A) functions. Major improvements in the reliability and correctness of systems are possible with disciplined design and development techniques applied during software development. This paper describes some of the techniques used in the Safeguard Systems Group at Los Alamos National Laboratory for various MC&A systems.

14455 **Field test of new TASTEX system for plutonium product verification at the Tokai reprocessing plant.** Kuno, Y.; Shigeoka, K.; Nishida, K.; Ikeda, H.; Hayashi, N.; Wachi, I. (Power Reactor and Nuclear Fuel Development Corp. (PNC), Tokai-mura, Naka-gun, Ibaraki-ken 319-11 (JP)); Hsue, S.T.; Sprinkle, J.K. (Los Alamos National Lab., (LANL), Los Alamos, NM (US)); Gunnink, R.; Ruhter, W.D. (Lawrence Livermore National Lab., (LLNL), Livermore, CA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 850-858(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This report describes the field test results of the New TASTEX system. This system consisting of the high resolution gamma spectrometer and the κ-edge densitometer can measure both isotopic abundances and concentration of plutonium simultaneously. Entire system is controlled by the multi-channel analyser and a multi-user computer. The system was designed and built under the Japan Support Program for Agency Safeguards (JASPAS). The software of this system developed at LANL and LLNL has been installed in the system assembled at the Tokai reprocession plant (TRP) in July 1985. In the course of campaigns from 1985 till 1988, field tests have been carried out on plutonium product solutions of TRP. The results of plutonium concentration and isotopic abundances obtained by the κ-edge densitometer and the high resolution gamma spectrometer (HRGS) have been compared with those by controlled potential coulometer and mass spectrometer respectively. Precision of plutonium determination with κ-edge densitometer is estimated approximately 0.7% and 1.0% for the freshly processed plutonium and the aged plutonium respectively. The scatters in the relative differences between HRGS and the destructive analysis (DA) detected on the results of freshly processed plutonium sample were 1.6%, 0.4%, 0.5%, 1.1%, 8.0% for Pu-238, Pu-239, Pu-240, Pu-241, Pu-242 respectively, whereas those on the results of aged sample were 1.4%, 0.5%, 1.1%, 1.1% for Pu-238, Pu-239, Pu-240, Pu-241 respectively.

14456 **Performance testing of volume instruments for nuclear process tank measurements.** Dionisi, M.; Aparo, M. (ENEA CRE Casaccia, COMB-MEPIS, Via Anguillarese 301, 00060 Rome (IT)); Suda, S. (Brookhaven Nat. Lab., Dept. of Nuclear Energy, Upton, NY (US)); Dragnev, T. (International Atomic Energy Agency, Vienna (AT));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 840-849(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The performances of bubbler-probe manometry, Time Domain Reflectometry and RF capacitance probes for use in determining the liquid level in process vessels were evaluated in a test programme at the Casaccia COMB-MEPIS laboratory, operated by the Italian Nuclear and Alternative Energy Commission (ENEA). The work, carried out in the summer of 1987, was done under a joint IAEA-ITALY -USA test programme of technical support for International Safeguards implementation. The fundamental outcome of the performance evaluations tests is the calibration and standardization data for the being calibrated. In addition to examples of the calibrations, the paper includes a comparison of key performance factors presenting tables and graphics as result of data analysis.

14457 **A portable surveillance unit.** Johnson, C.S.; Martinez, R.L.; Hale, W.R. (Sandia National Labs., Albuquerque, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 895-898(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The Portable Surveillance Unit (PSU) uses 8 mm video recorder technology to provide a system for surveillance situations that require quick setups. The PSU has its own internal battery for short duration operations without being plugged into AC power mains. Longer surveillance periods can be provided by plugging the PSU into AC power mains. The PSU has the capability to record 26,000 scenes at time intervals of 1 to 99 minutes. The videotapes from the PSU can be reviewed by the MIVS review station. A CMOS microprocessor is used to generate the control functions for the video recorder and to provide a simple user interface for unit programming.

14458 **International safeguards concerns of spent fuel disposal program.** Pillay, K.K.S. (Safeguards Systems Group, Los Alamos National Lab., Los Alamos, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 474-478(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The purpose of this paper is to stimulate discussions on the subject of safeguarding large quantities of plutonium contained in spent fuels to be disposed of in geologic repositories. All the spent fuel disposal scenarios examined here pose a variety of safeguards problems, none of which are adequately addressed by the international safeguards community. The spent fuels from once-through fuel cycles in underground repositories would become an increasingly attractive target for diversion because of their plutonium content and decreasing radioactivity. Current design of the first geologic repository in the U.S. will have the capacity to accommodate wasted equivalent to 70 000 Mt of uranium from commercial and defense fuel cycles. Of this, approximately 62 000 Mt uranium equivalent will be commercial spent fuel, containing over 500 Mt of plutonium and a variety of other valuable elements. International safeguards committments may require us to address the safeguards issues of disposing of such large quantities of plutonium in a geologic repository, which has the potential to become a plutonium mine in the future. This paper highlights several issues that should be addressed in the near term by U.S. industries and the DOE before geologic repositories for spent fuels become a reality.

14459 **Nuclear materials management and safeguards system (NMMSS).** Baird, P.W.; Jacobsen, S.E.; Matthews, W.B. III; Pedigo, R.B. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 298-300(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper describes the Nuclear Materials Management and Safeguards System (NMMSS) which is sponsored by the Department of Energy and the Nuclear Regulatory Commission. The system serves national security and program management interests, and international interests in the programs for the peaceful application of nuclear energy and nonproliferation of nuclear weapons. Within the scope of the NMMSS are found all nuclear materials applied and controlled under United States law and related international agreements, including U.S. nuclear materials production programs and U.S. private nuclear industrial activities. In addition, its national and international scope enables it to provide services to other organizations such as the Arms Control and Disarmamanent Agency, the Department of State, and the U.S. Congress.

14460 **Nuclear technology and the export control laws.** Munroe, J.L.; Pankratz, M.C.; Hogsett, V.H.; Lundy, A.S. (International Technology Div., Los Alamos National Lab., Los Alamos, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 242-247(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

Three basic US laws regulate the export of commodities, services, and technical data. People working in nuclear fields need to know of these laws and their impact on professional endeavors. Export of technical data means the communication of any information by oral, written, or any other means to foreign nationals within or outside the US. The medium for the communication may be a model, blueprint, sketch, or any other device that can convey information. If the data relates to items on one of the control lists, a license must be sought from the appropriated federal agency. The Militarily Critical Technologies List (MCTL), though not itself a control list, plays a major role in determining what technical data will require a validated license. The US Department of Energy (DOE), through Technical Working Gorup (TWG) 11, is responsible for the Nuclear Technology chapter of the MCTL. TWG 11 also prepares the Nuclear Technology Reference Book (NTRB), a classified guide to sensitive nuclear technology.

14461 **Minimizing the risk of hazardous material transports.** Seiler, M.C.; Moghissi, A.A. (Institute for Regulatory Science, P.O. Box 7166, Alexandria, VA (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 334-339(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

The selection of a particular route for the transport of hazardous materials places the population along that route at a certain level of risk. This paper discusses methods for reducing these risks. A two-pronged approach is taken: 1) to reduce the risk of certain scenarios occurring, and 2) to minimize and mitigate their consequences once they occur. The corresponding measures are discussed in the framework of cost-benefit and risk-trade-off evaluations. In the event of ties in the route selection process, a choice may be made on the basis of the risk reductions possible for each candidate route.

14462 **An effective materials control and accountability audit program.** Carnival, G. (Rockwell International, Rocky Flats Plant, Rocky Flats, CO (US)); Jewell, D.L. (Dept. of Energy, Albuquerque Operations Office, Albuquerque, NM (US)); Roberts, N.J. (Los Alamos National Lab., Los Alamos, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 815-817(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

An audit can be an extremely useful tool to assist both the DOE auditors and the contractor in performing their respective jobs. All too often audits are viewed as an adversarial meeting where one side tries to hide what it is doing and/or the other side attempts to "nail" someone. This adversarial relationship is often caused by misunderstandings of the purpose and uses of the audit. The authors have presented a scheme that will lead to a more productive audit from the perspective of both sides. If a procedure similar to the one outlined in this paper is in place and observed by all parties to the audit, it will produce both a useful product and a meaningful evaluation of the degree to which the contractor is adhering to established and generally accepted policies and practices.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 14369, 14371, 14372, 14373, 14396, 14415, 14458, 14459, 14460, 14810

14463 **(IAEA-INFCIRC—254(Add.11)) Communications received from certain Member States regarding guidelines for the export of nuclear material, equipment or technology. A further communication, dated 20 October 1988.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1988. 2p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705456/JAW.

Hard copies are available in English and Spanish from IAEA Division of Publications, Distribution Unit.

The document reproduces the text of a Note Verbale dated 20 October 1988 received by the IAEA Director General from the Permanent Mission of Spain relating to the export of nuclear material, equipment or technology.

14464 **(IAEA-INFCIRC—322(Add.2)) Communication received from the Resident Representative of Italy on behalf of the European Community. A Note Verbale dated 20 October 1988 from the Permanent Mission of Spain.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1988. 2p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705457/JAW.

Hard copies are available in English and Spanish from IAEA Division of Publications, Distribution Unit.

The document reproduces the text of a Note Verbale dated 20 October 1988 from the Permanent Mission of Spain stating that the Government of Spain has also adopted the common policy declaration adopted on 20 November 1984 by the Ministries for Foreign Affairs of the then ten Members of the European Community (INFCIRC/322) concerning the transfers of nuclear material, equipment and technology between the Member States of the Community.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 15494

14465 (IA—1440, pp 209) **/sup 99/Mo//sup 99m/Tc generator: 'thin' column development.** Ringler, G.; Shrem, S.; Zauber, H. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

14466 (IA—1440, pp 211-213) **Characteristic performance of the /sup 191/Os//sup 191m/Ir generator in bolus and continuous modes of operation.** Issachar, D.; Zemach, D.; Trumper, J. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 14770, 15861

14467 (CEA-CONF—9390) Hydrodynamics and radioactive tracers. Margrita, R.; Santos-Cottin, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Office des Rayonnements Ionisants). 1987. 4p. (In French). (CONF-8709393—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756404/JAW.

From National congress on process engineering; Nancy, France (21 Sep 1987).

Use of radioactive tracers for the description of fluid flow in chemical reactors is exposed. Method and operation are briefly described and examples of applications are given for different industries.

14468 (CIEMAT—613) Automatic procedure to keep updated the activity levels for each radionuclide existing in a radioactivity laboratory. Los Arcos, J.M. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 36p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756331/JAW.

An automatic procedure to keep updated the activity levels for each radionuclide existing in a radioactivity laboratory, and its classification according to the Spanish Regulations on Nuclear and Radioactive Establishments is described. This procedure takes into account the mixed composition of each source and whether it is sealed or the activity and mass variation due to extraction or evaporation in non-sealed sources. For a given date and time, the procedure prints out a complete listing of the activity of each radioactive source, the accumulated activity for each radionuclide, for each kind of radionuclide and the actual classification of the laboratory according to the legal regulations above mentioned. (Author)

14469 (INIS-mf—11348, pp 99) **Design and construction of shielding for gamma radiation.** Mireles Garcia, F. (Universidad Autonoma de Zacatecas (Mexico). Centro Regional de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

14470 (LA—11393-C-Suppl.) Plasma focus sources: Supplement to the neutron resonance radiography workshop proceedings. Nardi, V.; Brzosko, J. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 24p. (CONF-8707124—Suppl.). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006927/JAW.

From Neutron resonance radiography workshop; Los Alamos, NM, USA (27 Jul 1987).

Since their discovery, plasma focus discharges have been recognized as very intense pulsed sources of deuterium-deuterium (D-D) or deuterium-tritium (D-T) fusion-reaction neutrons, with outstanding capabilities. Specifically, the total neutron emission/shot, YN, and the rate of neutron emission, Y/sub n/, of an optimized plasma focus (PF) are higher than the corresponding quantities observed in any other type of pinched discharge at the same level of powering energy W_0. Recent developments have led to the concept and experimental demonstration of an Advanced Plasma Focus System (APF) that consists of a Mather-geometry plasma focus in which field distortion elements (FDEs) are inserted in the inter-electrode gap for increasing the neutron yield/shot, Y/sub n/. The FDE-induced redistribution of the plasma current increases Y/sub n/ by a factor ≃5-10 above the value obtained without FDEs under otherwise identical conditions of operation of the plasma focus. For example, an APF that is fed by a fast capacitor bank with an energy, W_0 = 6kJ, and voltage, V_0 = 16.5 kV provides Y/sub n/ {congruent} 4 {times} 10^9 D-D neutrons/shot (pure D_2 filling) and Y/sub n/ = 4 {times} 10^{11} D-T neutrons/shot (filling is 50% deuterium and 50% tritium). The FDE-induced increase of Y/sub n/ for fixed values of (W_0, V_0), the observed scaling law Y/sub n/ {proportional←to} W_0^2 for optimized plasma focus systems, and our experience with neutron scattering in bulk objects lead us to the conclusion that we can use an APF as a source of high-intensity neutron pulses (10^{14} n/pulse) in the field off neutron radiography (surface and bulk) with a nanosecond or millisecond time resolution.

14471 (PB—89-127328/XAB) Nuclear asphalt content gauge study. Research report (Final). Wagner, L.J. (Maryland State Highway Administration, Brooklandville (USA). Bureau of Tests). Apr 1988. 38p. NTIS, PC A03/MF A01.

This research ascertains if the Troxler Model 3241 Gauge could accurately determine the asphalt content of bituminous-concrete mixtures by nuclear means. The study was divided into three phases. Phase I was conducted in the Central Laboratory where a series of controlled tests were performed for variables that may effect the gauge's asphalt-content determinations. Phase II evolved into a cooperative study between the Maryland State Highway Administration (SHA) and several bituminous concrete producers. Phase III was to report the findings of the study and make a recommendation on the overall practical application of the gauge. The results indicate that the gauge can accurately determine asphalt contents on normal surface and base bituminous mixtures.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 14181, 14190, 14474, 14475, 14521, 15548

14472 (DOE/FTR—9006026) [US representative in a meeting of the Executive Committee on Hydrogen Technology, Brussels, Belgium, May 10--15, 1987]: Foreign trip report. Mezzina, A. (Brookhaven National Lab., Upton, NY (USA)). 20 May 1987. Contract AC02-76CH00016. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006026/JAW.

Participating countries (Belgium, Canada, Commission of European Communities, the Federal Republic of Germany, Japan, the Netherlands, Sweden, Switzerland and the United States of America), operating within the framework of the International Energy Agency Cooperative Agreement on Hydrogen Technology R and D, have committed to participation in semi-annual Executive Committee meetings and annual workshops for the various tasks implemented within the Agreement. A primary issue addressed by the Executive Committee dealt with the need to reinforce the Hydrogen R and D rationale in order to promote sustained commitments to the Agreement and to enhance prospects for stronger interactions among participants. It was agreed that global perceptions of the energy situation have removed the sense of urgency for developing alternatives or supplements to conventional fuels supplies. Yet, there was a strong consensus to underline the environmental costs of continued use of hydrocarbon fuels and how these costs could be reduced or even eliminated via exercise of the hydrogen technology options.

14473 Separation of CO/sub 2/ and H/sub 2/ mixtures using reactive ion exchange membranes. Way, J.D.; Hapke, R.L. (SRI International, Chemical Engineering Lab., Menlo Park, CA (US));. *American Chemical Society, Division of Gas and Fuel Chemistry, Preprints;* **33**: No. 1, 283-288(Jun 1988). (CONF-8806136—).

From American Chemical Society Division of Fuel Chemistry meeting; Toronto, Canada (5 Jun 1988).

Currently, the most widely used method for producing hydrogen is steam reforming of methane. The volatility in the price of natural has created increased interest in finding alternative feedstocks for the manufacture of hydrogen. Thus, it is appropriate at this time to conduct research which has the best opportunities for reducing H/sub 2/ production costs from coal gasification. Bartis and Marks (1984) have identified low energy separation processes such as membranes as a key research opportunity in reducing capital and operating costs and hence the H/sub 2/ production costs. They state that technical improvements in gas separation could lead to production cost reductions of 15 to 20 percent. Acid gases must be removed from the gas stream after gasification and prior to the

shift reaction. This separation step prevents sulfur poisoning of the shift catalysts and maximizes hydrogen production from the shift reaction. The second gas separation occurs after the shift reaction. CO/sub 2/ must be removed from the product stream to produce high purity H/sub 2/.

0802 Storage

REFER ALSO TO CITATION(S) 14472

0803 Transport

REFER ALSO TO CITATION(S) 14472

0804 Marketing And Economics

14474 **(NORCR—1980) An assessment of the potential future market for the production of hydrogen from water.** Bailey, P.S. (NORANDA Centre de Recherche, Pointe Claire, Quebec (Canada)). 1980. 183p. (CE—02262). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The object of this study was to determine the nature of the present and future Canadian demand for hydrogen derived from hydrocarbon resources, and to assess the relative competitiveness of electrolytic hydrogen in key market sectors. Current demand for electrolytic hydrogen is restricted to specialty markets, but some outlets are showing strong growth potential, and the overall market is broadening. Current and future markets for hydrogen in Canada are examined in the areas of petroleum refining, ammonia synthesis, methanol production, synthetic fuel production, coal liquefaction, forest biomass conversion, steelmaking, electricity generation and off-peak storage, use as a transport fuel, supplementing of natural gas, and use in fuel cells and space heating. Also, technologies are assessed for hydrogen electrolysis, hydrogen storage, and safety. It is conservatively estimated that hydrogen usage in Canada will expand at a rate of 2.7%/y over the next 45 years, with growth of electrolytic hydrogen usage expected to be at the faster rate of ca 4.5%/y. The overall market growth of electrolytic hydrogen will depend on numerous factors, including: the availability of electric power in Canada; the relative rate of cost increase between natural gas, oil, and electricity; the cost of producing hydrogen from coal; the success of present Canadian electrolyser development programs to improve the efficiency of unipolar electrolysers; design and cost improvements in the storage and transmission of gaseous and liquid hydrogen; and the strength of Canadian government policies directed to achieve energy self-sufficiency. 67 refs., 73 figs., 84 tabs.

14475 **(NORCR—8003) An assessment of the potential future market for electrolytic hydrogen in Canada for the period 1985 to 2025. Task 3.** Bailey, P.S. (NORANDA Centre de Recherche, Pointe Claire, Quebec (Canada)). 1980. 184p. (CE—02134). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The object of this study was to determine the nature of the present and future Canadian demand for hydrogen derived from hydrocarbon resources, and to assess the relative competitiveness of electrolytic hydrogen in key market sectors. Current demand for electrolytic hydrogen is restricted to specialty markets, but some outlets are showing strong growth potential, and the overall market is broadening. Current and future markets for hydrogen in Canada are examined in the areas of petroleum refining, ammonia synthesis, methanol production, synthetic fuel production, coal liquefaction, forest biomass conversion, steelmaking, electricity generation and off-peak storage, use as a transport fuel, supplementing of natural gas, and use in fuel cells and space heating. Also, technologies are assessed for hydrogen electrolysis, hydrogen storage, and safety. It is conservatively estimated that hydrogen usage in Canada will expand at a rate of 2.7%/y over the next 45 years, with growth of electrolytic hydrogen usage expected to be at the faster rate of ca 4.5%/y. The overall market growth of electrolytic hydrogen will depend on numerous factors, including: the availability of electric power in Canada; the relative rate of cost increase between natural gas, oil, and electricity; the cost of producing hydrogen from coal; the success of present Canadian electrolyser development programs to improve the efficiency of unipolar electrolysers; design and cost improvements in the storage and transmission of gaseous and liquid hydrogen; and the strength of Canadian government policies directed to achieve energy self-sufficiency. 67 refs., 73 figs., 84 tabs.

0805 Safety

REFER ALSO TO CITATION(S) 14472

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 14474, 14475, 15610

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 14162, 14324

14476 **(AC/R—I-933) An assessment of Agriculture Canada's Anaerobic Digestion Program.** Van Die, P. (Agriculture Canada, Ottawa, Ontario. Research Branch). 1987. 76p. (CE—02274). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Anaerobic digestion technology was taken from the laboratory to the pilot and farm-scale levels over a 13 year period. Utilization of methane for space heating, electrical generation and mobile power were the main energy aspects examined. This was supplemented with work on reducing the pollution potential of manure and food processing waste disposal and on protein and nutrient recovery for refeeding. Full scale digestors were then designed, constructed, operated and monitored at the mesophyllic temperature range of 20 to 45/sup 0/C on several swine, beef and dairy operations. It was found that anaerobic digestors can be operated year round and the biogas production can readily be used for space heating or generating electricity. Sufficient biogas is produced to provide supplemental heat to maintain the digestion process in the winter and for a farm's near self-sufficiency in the production of electricity. For small- to medium-sized Canadian farms, anaerobic digestion is neither feasible nor economically justified. Fairly complex digestion system designs were developed. Manure screening is almost essential to prevent plugging and reliable components such as circulation pumps, heat exchangers and temporary biogas storages are essential. Designs must be simplified and an integral component of the farm production systems. The recovery of protein was one of the main justifications for continuing the program but fell short of expectations. Results of research completed to date show that even when the technology is fully integrated into a farming operation involving energy production and recovery of protein, the energy and feed cost savings do not justify the large capital investment, operating costs and management time that the farmer must supply.

14477 **(DOE/ER/13730—2) Enzymological studies of one-carbon reactions in the pathway of acetate utilization by methanogenic bacteria: Annual technical report for the period February 1, 1988--January 31, 1989.** Ferry, J.G. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jan 1989. Contract FG05-87ER13730. 10p. NTIS, PC A02 - OSTI. Order Number DE89006907/JAW.

Our current understanding of the pathway of acetate conversion to methane in Methanosarcina thermophila is depicted. Our accomplishments this past year include phosphotransacetylase, the corrinoid/Fe-S protein component of the carbon monoxide dehydrogenase, and ferredoxin were characterized in further detail; two methyl transferase activities were resolved; and putative positive

clones containing the phosphotransacetylase gene were isolated from a lambda gt 11 DNA library of M. thermophila. The phosphotransacetylase was purified to electrophoretic homogeneity and characterized. The specific activity was 2555 micromoles of acetyl-CoA/min/mg. Optimum activity is obtained between 35-45 {degree}C and pH 6.5-7.5 in the presence of potassium or ammonium ions(ca. 100 mM). The enzyme is purified as a monomer of Mr 43,000. The Km and Vmax for CoASH and acetyl phosphate are 91 and 165 micromolar, and 5517 and 4025 micromoles/min/mg. Anti-phosphotransacetylase antibodies were raised in rabbits which were used in an immunoblot of crude extracts from acetate- or methanol-grown cells; the results indicate regulation of synthesis in response to the growth substrate. A mixed oligonucleotide probe was synthesized using the DNA sequence deduced from the N-terminal amino acid sequence. 6 figs.

14478 **(DOE/ER/13862—1) Genetics of bacteria that utilize one carbon compounds: Annual report, March 1, 1988--December 24, 1988.** Hanson, R.S. (Minnesota Univ., Navarre (USA). Freshwater Biological Inst.). Dec 1988. Contract FG02-88ER13862. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006058/JAW.

Bacteria that grow on methane, methanol and methylamine are a morphologically and physiologically diverse group of bacteria. Several of these bacteria have been shown to be clustered in two phylogenetically related groups by analysis of 16S RNA sequences. This information is useful for the synthesis of probes to detect methanotrophs in samples from bioreactors and in a variety of environments. We have observed considerable sequence homology in the methanol dehydrogenase genes of all gram negative methylotrophs. However, the upstream regulatory sequences of the two methylotrophic bacteria from which MDH genes have been completely sequenced have little similarity. The genetic maps of 12 genes required for MDH synthesis show several differences in two closely related methylotrophs. The MDH messenger RNA has a chemical half life of approximately one-minute although the protein represents 20% of the cellular protein. We now intend to map and sequence cloned genes encoding five proteins of Methylosinus trichosporium OB3B required for methane monooxygenase activity. We will continue to characterize the fourteen genes (and their gene products) required for MDH synthesis and will continue 16S rRNA sequencing in order to complete the molecular phylogeny of methanotrophic bacteria. 3 refs.

14479 **(DOE/PC/80015—13) Fischer-Tropsch slurry phase process variations to understand wax formation: Quarterly report, 1 October 1988--31 December 1988.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1988. Contract AC22-85PC80015. 33p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006704/JAW.

The effects of temperature and hydrogen/carbon monoxide ratio on carbon number product distribution from iron Fischer-Tropsch catalysts have been studied from recent selected data obtained in our laboratory and from analyses of the literature. These indicate that α_1 = 0.60-0.70 for the Schulz-Flory distribution up to about C_{10} for a variety of iron catalysts. α_1 is relatively insensitive to presence or absence of potassium and H_2/CO ratios up to about 10. Values of α_2 for the C/sub 10+/fraction vary from about 0.89-0.93 at 225{degree}C-263{degree}C, decreasing to about 0.82 at 310{degree}C. 28 refs., 11 figs., 1 tab.

14480 (IAEA-TECDOC—475, pp 17-23) **Production of methane from agricultural wastes - Studies of propionate degradation.** Sineriz, F. (Planta Piloto de Procesos Industriales Microbiologicas, Tucuman (Argentina)). Oct 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW. (CONF-8705360—).

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

The degradation of /sup 14/C-labelled propionate was studied under methanogenic conditions at initial concentrations of 10 or 100 mM in a salt solution with inoculum from a running industrial upflow anaerobic reactor. The degradation was quite slow at 10 mM propionate, but very much faster at 100 mM, measured as doubling time of methane in the medium. The reason for this big shift is not clear, being either the higher sodium or propionate concentrations. 6 refs, 2 figs.

14481 **(Juel—2220) Studies on alcohol synthesis with a Cu-ZnO-catalyst in recycle reactor.** Fink, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Technische Hochschule Aachen (Germany, F.R.)). Jul 1988. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756625/JAW.

The reaction kinetic behaviour of a Cu-ZnO-catalyst during the alcohol synthesis of synthesis gas (hydrogen, carbon oxides) is represented in this paper as a function of the essential reaction conditions. Measurements were undertaken in recycle reactor for the required experimental determination of the relations indicated. The differential measuring method thus achieved ensures possibilities of indicating the influence on the reaction by individual reaction conditions and also clarifying reaction sequences. On the basis of the general operating principle of these reactors, a special measuring methodology had to be developed for the reaction studied. Furthermore, it was also demonstrated for the technical design applied, namely the Berty reactor, that the results obtained met the requirements of the differential measuring method. Thermodynamic considerations show that the form and distribution of the alcohol mixtures are predetermined by the reaction kinetics but not by the chemical position of equilibrium. Largely primary straight-chain and also primary alcohols branched at the second carbon atom result at the catalyst used.

14482 **(NEI-DK—124) Anaerobic production of methane controlled by the partial pressure of hydrogen.** Rolin, C. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Bioteknologi). 1986. 114p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756276/JAW.

Literature on anaerobic digestion is reviewed with special emphasis on stability problems and the kinetics of hydrogen consumption by methanogens. The transfer of hydrogen between hydrogen producing and hydrogen consuming cells is discussed. A model description of the hydrogen concentration profile around a hydrogen consuming cell is presented. A quantitative treatment of gas/liquid interface mass transfer problems in experimentation with hydrogen grown methanogenic cultures is also given. Oxygen tolerance for methanogens and methods of cultivating strictly anaerobic species are briefly reviewed. The construction of a glove box and an anaerobic chemostat with a circulating gas phase is described. An enriched culture was grown at various dilution rates in a simple medium with hydrogen and carbon dioxide as the only sources of carbon and energy. Through growth yield and maintenance coefficient for this culture were resp. $Y^* = 0.36$ grammes cell dry matter per mole hydrogen and $m = 0.014$ moles hydrogen per gram cell dry matter per hour, but these estimates are somewhat uncertain. The maximal growth rate and the Monod constant could not be estimated because of the interfering effect of interfacial mass transfer. The growth of Clostridium pasteurianum in coculture with Methanobacterium formicicum at various dilution rates in a complex medium with glucose as the major source of carbon and energy is also described. Based on information gathered from literature and on the derived concentration profile around a hydrogen consuming cell, it is concluded that the mechanism responsible for interspecies hydrogen transfer is probably more complicated than was hitherto believed. Concentrations of dissolved hydrogen predicted from kinetic constants are higher than concentrations expected for thermodynamical reasons. It is suspected that a carrier mechanism may be involved. (AB).

14483 **(PNL-SA—16231) A thermocatalytic process for the gasification of high-moisture food processing wastes.** Butner, R.S.; Baker, E.G.; Elliott, D.C.; Sealock, L.J.; Banns, N.G. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 9p. (CONF-8811144—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003366/JAW.

From Food processing waste conference; Atlanta, GA, USA (2 Nov 1988).

Pacific Northwest Laboratory (PNL) is developing a thermocatalytic gasification system that converts high-moisture organic solid wastes to a medium-Btu (450 to 550 Btu/scf) fuel gas. High-COD liquid wastes can also be treated but may require the use of supplemental fuel. A 1-liter batch reactor has been used to gasify a number of food processing wastes, including fruit pomace, potato peeling sludge, cheese whey, and brewer's spent grain. The waste is gasified in the presence of a nickel catalyst at 350{degree}C to 400{degree}C and 2000 to 4000 psig. Carbon conversion to gas is typically 90 to 95 wt% after 15 to 30 min. Methane yields of up to 6.3 scf/dry pound of spent grain have been obtained, with the methane content of the raw gas ranging from 45 vol% to 55 vol%. Data obtained from the batch reactor studies indicate that the process is a net energy produced for most organic waste streams containing more than 2 wt% solids. The PNL process is currently being tested in a continuous reactor system designed to obtain reactor engineering and design data which will be required for process scaleup. Results from both the batch and continuous reactor systems are presented in this paper. Plans for a pilot-scale demonstration facility are also discussed. 2 refs., 2 figs., 2 tabs.

14484 **A novel extruder-feeder reactor system for biomass liquefaction.** White, D.H.; Wolf, D.; Reyes, B.; Zhao, Y. New York, NY; American Institute of Chemical Engineers (1987). 12p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 32H.

A need existed in the 1970's to pump high concentrations of biomass solids into reactors under high pressure on a continuous basis. A modified plasticating single screw extruder was developed, capable of pumping slurries as high as 60 wt % wood as compared to only 10-20 wt % in conventional piston pump systems. The ability to handle such concentrated slurries which are in solid form at ambient temperatures is expected to improve direct liquefaction wood oil quality and process economics. Various preliminary process design and economic studies indicate that the utilization of this newly-developed extruder-feeder in biomass direct liquefaction processes could lead to one or more of the process improvements listed below. The extruder-feeder acts simultaneously as both a feed preheater and a pumping device into a 3,000 psi pressure reactor in the biomass liquefaction process. It could prove to be of importance in other processes where high concentration of solids in liquids are to be handled, like in the pulp and paper industry, hydrolysis of wood or other cellulosics, other biomass liquefaction processes, coal liquefaction processes and some biomass gasification processes.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 14927, 15095

14485 (EMR—ER80-8F, pp 45-69) **Energy from biomass through fermentation: ethyl alcohol.** Seaton, W. (Stone & Webster Canada, Toronto). 1980. (In French). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

Ethanol, produced on a large scale, is felt to have a great potential for use as an additive to transportation fuels. This paper describes processes that can be used to make ethanol fuels from biomass, with simple production processes giving maximum yield, and using techniques appropriate to the chemical industry. Industrial-scale production is felt to have advantages including high yield and efficiency, and ability to make economical use of by-products. Raw materials include agricultural wastes and crops specifically designed for alcohol production. Theoretical alcohol production figures are given, per hectare, for crops including corn, wood, sugar cane, and beets in different world regions. The production process itself includes the steps of saccharification, fermentation, and distillation. Certain new developments in these areas are discussed, including research in wood hydrolysis, genetic optimization of microorganisms used in fermentation, and fractionation methods having a low energy consumption. Utilization of residues is also part of the production process, affecting the economics and environmental aspects of production; the main by-product, the stillage, can be made into animal feed. The production plant can be optimized for maximum energy efficiency, using known methods such as waste heat recovery, and proper use of the feedstock; for example, a plant making alcohol from sugar cane can use cane residues as a fuel for distillation. Examples are given from Australia, India, and the USA to illustrate the variety of alcohol plants possible and their adaptation to local conditions. Some typical costs for the steps of the production process are listed. 13 refs., 3 figs., 6 tabs.

14486 **(STEV-ALTD—88-2) Progress report 1 of the project 266 099-1 Biogas SLU.** Svensson, B. (Statens Energiverk, Stockholm (Sweden)). (Statens Energiverk, Stockholm (Sweden)). 1988. 10p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756294/JAW.

Hydrogen and acetate utilizing methanogenic bacteria, especially those tolerant to high ammonia concentrations, have been isolated or are within the process of enrichment. The experiments of speeding up the establishment of stable processes at high ammonium concentrations, by inoculation with ammonium tolerant strains of methanogenic bacteria, have been difficult to reproduce. They may later be repeated for more defined systems than those so far worked with. One of our isolated methanogens most probably contain at least one plasmid, which offers the possibility to get access to molecular biological probes for the future research within the field of anaerobic microbiology of the biogas process. Enrichment for other important microorganisms than the methanogens in the biogas process have been initiated on cellulose and uric acid. The work with the new Clostridium is finished and will be published during the autumn. The studies of substrate preferences among methanogens at low temperatures started this summer.

14487 **Production of gluten and germ by ethanol fermentation of raw corn.** Urbana, IL; Coordinated Science Laboratory (1987). 76p. Coordinated Science Laboratory, Univ of Illinois at Urbana-Champaign, 1101 W Springfield Ave, Urbana, IL 61801.

The Illinois ethanol fuel industry has grown to be an important part of our state's economy over the past 10 years. It provides an additional market for Illinois' abundant corn production, provides many industrial jobs, and substitutes a home-grown renewable energy resource for imported oil. More than 30 percent of all gasoline sold in Illinois contains 10 percent ethanol. The economics of producing ethanol from corn is strongly affected by the byproduct value and by the energy required in the production process. This document reports on efforts to research a new microbial process that would improve the ethanol fermentation process in both these areas. The new process allows direct fermentation of corn starch to ethanol without the usual requirement of cooking the corn. This reduces the amount of energy needed for production and recovers the protein-containing gluten and oil-containing germ with all of the original food value intact.

14488 **On-farm anaerobic digester and fuel alcohol plant.** Urbana, IL; Coordinated Science Laboratory (1985). 30p. Coordinated Science Laboratory, Univ of Illinois at Urbana-Champaign, 1101 W Springfield Ave, Urbana, IL 61801.

An anaerobic digestion system was constructed and set up on a southern Illinois farm. The anaerobic digestion system was designed to be coupled with a fuel alcohol plant constructed by the farm family as part of an integrated farm energy system. The digester heating can be done using waste hot water from the alcohol plant and biogas from the digester can be used as fuel for the alcohol production. The anaerobic digestion system is made up of the following components. A hog finishing house, which already had a slotted floor and manure pit beneath it, was fitted with a system to scrape the manure into a feed slurry pit constructed at one end of the hog house. A solids handling pump feeds the manure from the feed slurry pit into the digester, a 13,000 gallon tank car body which has been insulated with styrofoam and buried underground.

Another pump transfers effluent (digested manure) from the digester to a 150,000 gallon storage tank. The digested manure is then applied to cropland at appropriate times of the year. The digester temperature is maintained at the required level by automated hot water circulation through an internal heat exchanger. The biogas produced in the digester is pumped into a 32,000 gallon gas storage tank.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 14512, 14536, 15931

14489 **(CONF-8709398—) Wood waste heat supplies. Proceedings.** (Verein zur Foerderung der Eigenstaendigen Regionalentwicklung in Hessen e.V. (VER), Melsungen (Germany, F.R.); Energieladen, Kassel (Germany, F.R.)). 1987. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770229/JAW.

From Meeting on wood waste heat supplies; Eschwege, F.R. Germany (22 Sep 1987).

Papers were held on experiences gained in the operation of auto-feed wood burning furnaces, technical and economic aspects, rural heat supply structures, as well as on emission tests and air pollution regulations. Separate records are available for five papers.

14490 (CONF-8709398—, pp 1-10) **Federal Clean Air Act requirements and state of the art of wood burning furnace air pollution control.** Puder, F. (Umweltbundesamt, Berlin (Germany, F.R.)). 1987. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770229/JAW.

From Meeting on wood waste heat supplies; Eschwege, F.R. Germany (22 Sep 1987).

According to provisional estimations of the Federal Environmental Agency more than 30 per cent of domestic furnace hydrocarbons and odors are caused by wood burning furnaces. Apart from soot, tar, carbon monoxide and odorous substances polycyclic aromatic hydrocarbons are known to be the most harmful ones among the substances involving health hazards. The paper concludes with brief remarks on the draft of a revised version of the Federal Clean Air Act.

14491 (CONF-8709398— pp 28) **Experiences gained in the operation of auto-feed wood burning furnaces.** Apfelbeck, R. (Technische Univ. Muenchen, Freising (Germany, F.R.). Landesanstalt fuer Landtechnik Weihenstephan). 1987. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770229/JAW.

From Meeting on wood waste heat supplies; Eschwege, F.R. Germany (22 Sep 1987).

For about 13 years a team of the Bayerische Landesanstalt fuer Landtechnik (Freising-Weihenstephan, Bavaria) has been active in the field of wood combustion. Apart from team developments, activities comprise the testing and scientific supervision of innovative systems in pilot plants as well as consultative services in the frame of an exhibition of boilers. The description of different wood chip feeding and wood combustion systems facilitates access to the respective results and experiences with recommendations derived from them. The appropriate planning and installation of automatic wood burning furnaces allows for an environmentally compatible wood waste-based generation of heat. The reliable and trouble-free operation of plants largely depends on the owner's management and way of handling them.

14492 (CONF-8709398—, pp 29-37) **Wood burning furnaces in Austria - technical and economic aspects.** Bergmayr, M. 1987. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770229/JAW.

From Meeting on wood waste heat supplies; Eschwege, F.R. Germany (22 Sep 1987).

In Austria, individual or common automatic wood burning furnaces are typical of the rural areas. Larger-scale systems are either used for individual in-house or general district heat supplies.

14493 (CONF-8709398—, pp 38-44) **Common heat supply structures in rural areas.** Schulz, W. (ARENHA G.m.b.H., Hannover (Germany, F.R.)). 1987. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770229/JAW.

From Meeting on wood waste heat supplies; Eschwege, F.R. Germany (22 Sep 1987).

Reference is made to common fuel production or fuel supply systems on the basis of wood or straw. With but a smaller staff of trained personnel responsible for the systems' maintenance and supervision the manpower needed is reduced to a minimum. To the benefit of all, risks and expenses are shared among the members of the community.

14494 **(SNCT—1979) Study on energy and chemicals from wood.** (SNC Tottrup, Edmonton, Alberta (Canada)). [1979]. 105p. (CE—02232). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was commissioned to review current technology and to determine the practicality of utilizing available wood supplies either for energy generation or for wood chemicals. Its scope was limited to Alberta and to sawmill and plant mill wastes (sawdust, bark, and planer shavings but not pulp chips) from mills now utilizing spruce and pine, and total biomass from low quality poplar stands. Specific objectives included an analysis of Alberta's wood resources to determine the wood energy/chemical potentials, the most promising Alberta locations for plants, which wood energy/wood chemical developments might be feasible, the energy cost likely necessary to make currently uneconomic developments viable, and new developments having sufficient potential to warrant development support. Three sites were found to have sufficient aspen resource to support a large scale energy or chemical plant: High Prairie, Slave Lake, and Whitecourt. Three other sites (High Level, Manning and Lake La Biche) have sufficient gross volume to support large plants for up to 40 years, but are unlikely to do so on a substained yield basis. Wood can only be considered as a source of power and heat in special circumstances where there are large quantities of wood waste available, a fairly large demand for both heat and power, and no other cheap fuel available. Large scale chemical plants based on the aspen resource are not economically feasible in Alberta. Smaller scale production of ammonia from wood waste could be economically feasible if the plant were sized to meet local market requirements, and if high pressure gasification technology can be developed. Included is an annotated bibliography.

14495 **Inventory of waste-to-energy facilities in Illinois.** Urbana, IL; Coordinated Science Laboratory (1987). 40p. Coordinated Science Laboratory, Univ of Illinois at Urbana-Champaign, 1101 W Springfield Ave, Urbana, IL 61801.

The Illinois Department of Energy and Natural Resources (IDENR) is pleased to publish this inventory of waste-to-energy facilities in this state. The passage of the 1986 Illinois Solid Waste Management Act was responsible for the establishment of the Office of Solid Waste and Renewable Resources within the agency, and established the following priorities for the solid waste management options in the state: 1. waste reduction 2. recycling and reuse 3. incineration for energy recovery 4. incineration for volume reduction 5. landfill disposal. The waste-to-energy facilities listed in this publication address a major objective of this legislation and provide an important portion of the strategy in addressing the goals of the Solid Waste Management Act. This inventory is intended as a guide to waste-to-energy facilities in Illinois. Inclusion of engineering, construction, or other firms in this inventory does not in any way indicate an endorsement by the ENR, but are strictly for information purposes.

14496 **Refuse-derived fuels.** Ohlsson, O.O. (Energy from Municipal Waste Program, Argonne National Lab., Argonne, IL (US));. pp v of Proceedings of the conference energy from solid waste: An option for local government. Lexington, KY; Kentucky Energy Cabinet (1987). (CONF-870536—).

From Energy from solid waste: an option for local government; Louisville, KY, USA (13 May 1987).

The rising cost of refuse disposal, coupled with the decreasing availability of land suitable for the siting of new landfills have greatly accelerated the use of refuse-derived fuel (RDF) processing systems as a viable technology for the disposal of our municipal solid waste. The energy products produced by an RDF processing facility - electricity and/or steam, as well as the recovery of other valuable materials from the waste stream, coupled with the inherent flexibility of the RDF technology to be used in varying forms, over a wide range of combustion technologies, makes it an extremely desirable waste-to-energy system. Use of an RDF prepared fuel product can also provide a potentially beneficial reduction of air emissions and trace metals in the ash when compared to the burning of unprocessed solid waste. This paper discusses the problems which have been encountered in the past with RDF systems; the current status of these facilities including institutional considerations and system economics; and the future potential of RDF processing systems.

13 HYDRO ENERGY

1301 Resources And Availability

14497 **(AIL—8504) Hydrologic design methodologies for small-scale hydro at ungauged sites - Phase 2. Feasibility level study for Atlantic provinces. Summary report.** (Acres Consulting Services Ltd., Niagara Falls, Ontario (Canada)). 1985. 24p. (CE—02275). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Work has been completed to develop methodologies for generating synthetic hydrologic data at potential sites in Atlantic Canada for small-scale hydroelectric power plants, such sites not being located at or near gauging stations normally used to evaluate the streamflow regime. This report summarizes these methodologies which have been developed into a series of computer programs. Within each province covered, two homogeneous regions were selected, and within each region a number of hydrometric gauges were chosen for the development of correlation equations relating the streamflow and flood flow hydrology characteristics to physiography and hydrometeorology. Three methods of synthesizing a hydrologic record for ungauged sites were then developed: proration on drainage area and mean annual runoff; determining the flow duration curve from an index curve by using regression equations; and modelling the streamflow by use of an autoregressive moving average flow. These methods, and their applicability in the various regions, are briefly evaluated, and the differences in what they attempt to show are discussed. Evaluation of flood flows, required to size diversion facilities and spillway capacity, is based on regional flood analyses. Various methods are available for evaluating the energy available from a potential plant, and the computer programs can be used to simulate plant output on a daily basis, taking into account reservoir storage. 2 figs., 2 tabs.

14498 **(AIL—8504) Hydrologic design methodologies for small-scale hydro at ungauged sites. Phase 2. Feasibility level study for Atlantic provices. Applications manual.** (Acres Consulting Services Ltd., Niagara Falls, Ontario (Canada)). 1985. 239p. (CE—02277). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This manual, in conjunction with a set of computer programs, provides generalized methods of hydrologic analyses for feasibility-level studies of small hydroelectric power plants in the Atlantic region of Canada, primarily at ungauged sites. Techniques have been developed within 6 homogeneous hydrologic regions of New Brunswick, Nova Scotia and Newfoundland to enable the user to determine a synthetic time series of daily discharge and to estimate flood flows for ungauged or sparsely gauged locations. All of the developed methodologies for hydrologic data synthesis, including proration, flow duration curve methods, and autoregressive moving average methods, have been incorporated into the computer programs, which can be used to estimate the hydrologic characteristics of a potential power plant site. In addition, programs have been developed to estimate the power and energy capabilities of the site. An evaluation of the methodologies, using a power and energy simulation model for various installed capacities and storages, indicated that all these techniques gave reasonable results, with some methods being more suitable than others in particular regions. Two potential small-scale hydro sites were selected in each province, and sample applications of the developed methodologies were undertaken for these sites. A summary of the results of those simulations is included. 21 refs., 13 figs., 76 tabs.

14499 **(AIL—8504) Hydrologic design methodologies for small-scale hydro at ungauged sites. Phase 2. Feasibility level study for Atlantic provinces. Study documentation report.** (Acres Consulting Services Ltd., Niagara Falls, Ontario (Canada)). 1985. 316p. (CE—02276). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Work was undertaken on the development of hydrologic design methodologies for feasibility-level studies of potential small-scale hydroelectric power plant sites in the Canadian Atlantic region. Particular emphasis was given to hydrologic data synthesis for ungauged sites, flood flow estimation, and development of appropriate computer models. This report presents the results of a literature review and evaluation of potential hydrologic methodologies, the methods used for selecting regions for developing such methodologies and the collection of data from such regions, and a description of the development of the methodologies to be used. Two homogeneous regions in each province studied (New Brunswick, Nova Scotia and Newfoundland) were selected, and in each region, hydrometric gauges were chosen to be used for developing appropriate correlation equations for streamflow hydrology and flood flows. For the regional analyses, three methods for hydrologic data synthesis were developed: proration on drainage area and mean annual runoff; determining flow duration curves by using regression equations; and an autoregressive moving average model. Evaluation of the three techniques was undertaken, showing the reasonableness of their results. Traditional index flood and frequency curve slope prediction methods were used for regional flood analyses. Computer models were developed, incorporating the hydrologic methodologies, and also used to simulate power and energy yields of hydro plants. Sample applications of the developed methodologies at two sites in each province were undertaken, and the report also includes the results of these simulations. 57 refs., 27 figs., 80 tabs.

14500 **(CHA—1986) Hydrologic design methodologies for small-scale hydro at ungauged sites. Phase 2A, British Columbia. Theory and modelling procedures, integrated method for power analysis (IMP).** (Howard (Charles) and Associates Ltd., Victoria, British Columbia (Canada)). 1986. 78p. (CE—02279). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Integrated Method for Power Analysis (IMP) package was developed for use in simulating hydrologic data and power plant performance at ungauged sites for potential small-scale hydroelectric generation in British Columbia. The IMP package consists of five basic components, and four of those components are discussed in this report. Discussion covers methodologies and mathematical models used, data collection and analysis, definitions and assumptions, parameters considered, and possible limitations of the models. The atmospheric model is used to generate average annual precipitation and 24-h, one-in-ten-year maximum rainfall. The flood frequency methodology component is based on the mathematical method of derived probability distribution functions, and uses site-specific topograpic information and information from the atmospheric model to generate the flood frequency curve. The watershed

model component performs a daily snow accumulation and melt accounting based on the area elevation curve for the watershed and allocates runoff to different components of the hydrograph; it generates a continuous daily time series of streamflow data. The power study methodology component determines the daily energy output of a run-of-river or reservoir storage site, and incorporates a linear programming structure to maximize energy production within constraints on reservoir, penstock, and powerhouse capabilities. 31 refs., 12 figs., 17 tabs.

14501 **(CHA—8603) Hydrologic design methodologies for small-scale hydro at ungauged sites. Phase 2A, British Columbia. Summary report. Integrated method for power analysis (IMP).** (Howard (Charles) and Associates Ltd., Victoria, British Columbia (Canada)). 1986. 12p. (CE—02281). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Analysis of the feasibility of sites for small-scale hydroelectric power generation in British Columbia can be a difficult process in cases where gauged streamflow data are not available. This report outlines the capabilities of a package of computer programs, designed to aid the planner of small-scale hydro projects in evaluating the hydrology and energy potential of ungauged sites in that province. The programs were developed by using appropriate programming and hydrological research that had already been done, and taking advantage of experience already available from previous use of components of the package. As the province's mountainous terrain, with numerous microclimates, precluded use of methods of regional analysis based on regression or comparison with gauged streams, the package was developed on the basis of a conceptual model of physical processes on the land and in the atmosphere. The resulting package, the Integrated Method for Power Analysis, consists of five basic components: an atmospheric model of annual precipitation and one-in-ten-year 24-h maximum rainfall; a watershed model that will generate streamflow data based on information from the atmospheric model; a flood frequency analysis system that uses site-specific topographic information and information from the atmospheric model to generate a flood frequency curve; a hydroelectric power simulation program which determines the daily energy output for a run-of-river or reservoir storage site; and a graphics analysis package that provides direct visualization of atmospheric and streamflow data, and the results of watershed and power simulation modelling. 2 figs., 1 tab.

14502 **(CHA—8603) Hydrologic design methodologies for small-scale hydro at ungauged sites. Phase 2A, British Columbia. Primer for Integrated Method for Power Analysis (IMP).** (Howard (Charles) and Associates Ltd., Victoria, British Columbia (Canada)). 1986. Vp. (CE—02280). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides a user's manual for the Integrated Method for Power Analysis (IMP) series of programs, developed to aid in evaluating small-scale hydroelectric power sites in British Columbia. The primary objective of IMP is to address the problem posed by hydroelectric development at sites completely lacking in streamflow records. The province's mountainous terrain, with numerous microclimates, precluded methods of regional analysis based on regression or comparisons with gauged streams; instead, a conceptual model of physical processes on the land and in the atmosphere was used as a basis for developing IMP. The IMP package consists of five basic components: an atmospheric model of annual precipitation and 1-in-10-year 24-h maximum rainfall; a watershed model that will generate a daily series of streamflow data; a flood frequency analysis system that uses site-specific topographical information and information from the atmospheric model to generate the flood frequency curve; a hydroelectric power simulation program which determines the daily energy output for a run-of-river or reservoir storage site; and a graphics analysis package which provides direct visualization of atmospheric and streamflow data, and the results of watershed and power simulation modelling. Within each component of the program, the program requirements and capabilities are discussed. A series of sample screens are shown, illustrating the use of the IMP package for a particular simulation. 18 figs., 2 tabs.

1302 Site Geology And Meteorology

REFER ALSO TO CITATION(S) 14500, 16165

1306 Environmental Aspects

14503 **(DOE/BP/63461—1) State of Washington augmented anadromous fish health monitoring: Annual report, 1986.** Amos, K.; Hopper, K.; Michak, P.; Rogers, B.; Gearheard, J.; Roberts, S.; Chase, D.; Bolding, B. (Washington State Dept. of Fisheries, Olympia (USA); Washington State Dept. of Wildlife, Olympia (USA)). May 1987. Contract AI79-86BP63461. 73p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE88005293/JAW.

This document contains two papers on fish health and disease prepared by separate agencies but as part of a common effort. The entire report represents the annual progress report on the subject by the Bonneville Power Administration. Each of the individual reports were processed separately for the data base. (TEM)

14504 (DOE/BP/63461—1, pp 41, Paper 2) **Augmented fish health monitoring for Washington Department of Wildlife.** Gearheard, J.; Roberts, S.; Chase, D.; Bolding, B. May 1987. NTIS, PC A04/MF A01 - OSTI. Order Number DE88005293/JAW.

In State of Washington augmented anadromous fish health monitoring: Annual report, 1986.

This project summarizes fish health related data from anadromous production facilities in the Columbia River drainage. Washington Department of Wildlife rears winter-run steelhead, summer-run steelhead and sea-run cutthroat in these facilities although not all three species/strains are located each of these stations. 7 refs., 1 fig., 26 tabs.

14505 (DOE/BP/63461—1, pp 30, Paper 1) **Augmented fish health monitoring.** Amos, K.; Hopper, K.; Michak, P.; Rogers, B. May 1987. NTIS, PC A04/MF A01 - OSTI. Order Number DE88005293/JAW.

In State of Washington augmented anadromous fish health monitoring: Annual report, 1986.

Natural anadromous salmonid production in the Columbia River Basin has decreased due to hydroelectric facilities and other causes. Artificial propagation of fish is the typical means of mitigating this loss. The survival of these hatchery smolts varies widely between locations and years. This study will provide data to improve the health, quality, and thus survival of artificially produced smolts. Bonneville Power Administration formed an interagency technical committee to determine the minimum level of fish health monitoring needed in the Columbia Basin. Members include both administrative and technical personnel from four state agencies, and from the US Fish and Wildlife Service. The committee developed a monitoring program which includes agreed upon levels of testing in these areas: specific fish health parameters, water quality, and prevalence of certain pathogens. 2 refs., 4 figs., 9 tabs.

14506 **(GAO/RCED—88-82) Energy regulation.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1988. 20p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report focuses on (1) the Federal Energy Regulatory Commission's plans for using an alternative to the Cluster Impact Assessmednt Procedure - the River Basin Environmental Impact Statement procedure - to assess the cumulative impact of hydroelectric projects and (2) deficiencies cited on how FERC carries out cumulative impact assessments and whether the development of comprehensive river basin plans can help address these deficiencies.

14 SOLAR ENERGY

14507 **(NRC—SEP1) The National Research Council Solar Energy Program.** Gringnon, A.A. (National Research Council of Canada, Ottawa, Ontario). 1978. 30p. (In English and French). (CE—02249). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A national solar energy project was created in Canada during 1977-78 in order to establish where and when solar energy can be advantageously used in Canada, and to undertake, promote, and sponsor the development in Canada of solar technology and an industrial capability based on that technology. This report outlines the place of this program within the broader Canadian federal energy programs, and describes the following subprograms in solar energy: fundamental studies, to gain technical information on the uses and limitations of solar heating in Canadian buildings; solar energy resources assessment; advanced scientific projects in photovoltaic and photochemical devices and systems; industrial technology and product development, to promote the evolution of the Canadian solar industry; systems trials, to obtain information on actual installed systems and to conduct demonstration programs; agricultural applications, notably in greenhouses; solar heating of commercial buildings; monitoring, to accumulate and analyze data on solar system performance and to use these data to verify analytical tools; test methods and standards; and information/liaison activities to facilitate collecting, organizing, and distributing solar information.

1401 Resources And Availability

14508 **Thermal analysis of heat storage canisters for a solar dynamic, space power system.** Wichner, R.P.; Solomon, A.D.; Drake, J.B.; Williams, P.T. (Martin Marietta Energy Systems, Oak Ridge, TN (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

A thermal analysis was performed of a thermal energy storage canister of a type suggested for use in a solar receiver for an orbiting Brayton cycle power system. Energy storage for the eclipse portion of the cycle is provided by the latent heat of a eutectic mixture of LiF and CaF/sub 2/ contained in the canister. The chief motivation for the study is the prediction of vapor void effects on temperature profiles and the identification of possible differences between ground test data and projected behavior in microgravity. The first phase of this study is based on a two-dimensional, cylindrical coordinates model using an interim procedure for describing void behavior in 1-g and microgravity. The thermal analysis includes the effects of solidification front behavior, conduction in liquid/solid salt and canister materials, void growth and shrinkage, radiant heat transfer across the void, and convection in the melt due to Marangoni-induced flow and, in 1-g, flow due to density gradients. A number of significant differences between 1-g and 0-g behavior were found. The resulted from differences in void location relative to the maximum heat flux and a significantly smaller effective conductance in 0-g due to the absence of gravity-induced convection.

1403 Economics

REFER ALSO TO CITATION(S) 14561, 14562, 15062, 15063, 15064

14509 (EMR/CRE—8012, pp 7-10) **The results of a study examining the possible impact of solar space heating on the electrical utility in New Brunswick.** Slater, K. (Slater Energy Consultants). 1980. Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). (CONF-8005266—; CE—02255).

From Potential impacts of the deployment of solar heating on electrical utilities workshop; Ottawa, Canada (12 May 1980).

This study, to calculate the worth to the electrical utility of the solar systems installed, was done in two stages. First, the load that the utility would have to supply if the solar systems were not installed was examined and the cost to the utility of supplying that load calculated. The loads that would result if the solar systems were installed were next examined and the costs to the system of supplying that load computed as well. Each of these calculations was done on an hourly basis over the whole year. The power system model used represented the solar systems and provided a basis for calculating the worth of solar to the utility. Both the variable cost savings and the capital cost savings to the utility of installing solar were considered. The variable cost savings included fuel and incremental operating and maintenance cost savings associated with the solar component. The capital cost savings were based on the cost of conventional plants giving the same output and reliability as the solar. The worth of the solar system was the total of these cost savings. Large numbers of different configurations of solar installations were evaluated in addition to the worth of solar systems with a back-up supply control. Two different types of back-up control were investigated: a 14 hour storage and a 4-hour shut-off back-up. The installation of up to 60,000 space and domestic space water installations and up to 120,000 single family water heating systems were modelled. The viability of the solar system, in comparison with supplying electricity for the same use, seems to depend on controlling the back-up.

14510 **Photovoltaic system technology.** Jones, G.J. (Sandia National Laboratories, Albuquerque, NM (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

Photovoltaic system technology has matured during the last decade. It has now achieved the point at which there remain no major technical barriers to its successful use. As collector costs are reduced, more and more photovoltaic applications will become economical, with widespread utility generation as the ultimate goal. This paper has attempted to convey the level of system technology maturity by discussing four of the most often asked questions regarding the technology. This discussion does not represent the total data available and should only be considered to be representative of the depth to which issues have been investigated. The research into systems technology is continuing today, with the focus more on user specific issues, and the reduction of the complex design techniques and guidelines to more user friendly forms. The photovoltaic systems activity is actively involved in an aggressive technology transfer program at this time, and has set up a Design Assistance Center to aid in the effort. Through the means of the Center, it is hoped that the existent technology base will receive wider distribution, and the adoption of the technology will be accelerated.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 15064

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 14477, 14478, 14480, 14484, 14487, 14488, 14490, 14589, 14926, 14934, 15084, 15093, 15422, 16022, 16027, 16071

14511 **(BMFT-FB-T—86-073) Biomass production in forest plantations used as raw material for industry and energy. Final report.** Ahuja, M.R.; Muhs, H.J. (Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Grosshansdorf (Germany, F.R.). Inst. fuer Forstgenetik und Forstpflanzenzuechtung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1986. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756619/JAW.

European aspen (Populus tremula), quaking aspen (Populus tremuloides), and their hybrids (hybrid aspen) are short-rotation, fast growing forest tree species, that apparently hold potential for biomass and energy production. Because of inherent difficulties in vegetative propagation in aspen, it has not been possible to propagate selected aspen and hybrid aspen tress on a large scale. Therefore, the aim of this project was to develop unconventional meth-

ods of vegetative propagation in aspen that can easily be adapted to nursery practices and are also cost-effective. Explants from buds, leaves, stems, and roots were cultured on a modified Woody Plant Medium for the purposes of microvegetative propagation. Protoplasts were also cultured for regenerative studies. Mainly the bud explants were employed for microvegetative propagation. A 2-step micropropagation method, which is commmercially feasible, has been developed for aspen. This method involves: (1) culture of bud explants on a medium for bud conditioning and microshoot proliferation, and (2) rooting of microshoots in peat-perlite mix. By employing this 2-step micropropagation method, several thousand plants have been regenerated from about 50 mature selected aspen and hybrid aspen trees ranging from 1 to 40 years of age. Following transfer to field conditions, tissue culture derived plants exhibited vigorous growth and attained a height of 1.5-2 meters in the first growing season. (orig.) With 23 refs., 1 tab., 20 figs.

14512 **(CONF-8711276—1) Coburning in institutional incinerators.** Green, A.; Prine, G.; Yost, R.; Green, B.; Williams, D.; Schwartz, J.; Wagner, J.; Clauson, D.; Proctor, B.; Feinberg, A. (Florida Univ., Gainesville (USA)). 1987. 19p. OSTI - Air Pollution Control Association, P.O. Box 2861, Pittsburgh, PA 15230. Order Number TI89005095/JAW.

From APCA international specialty conference on thermal treatment of municipal, industrial and hospital wastes; Pittsburgh, PA, USA (3 Nov 1987).

Our program, initiated in 1980, originally sought to replace imported oil by coburning coal and natural gas in oil designed boilers. Success came in 1986 with the co-combustion of coal water slurries (CWS) and natural gas (G) in a 20 MMBtu/hr watertube oil designed boiler. We achieved stable flames over broad load levels, good boiler efficiencies, low emissions, benign ash and--by increasing the G/CWS ratio--full power rating. Our biomass-waste co-combustion experiments will utilize a two chamber ram fed incinerator. Advanced analytical techniques will be used to measure available energy and stack emissions from various waste-biomass-fossil fuel combinations. Heating values, H/C ratios, percent moisture, emissions, prices and tipping fees are discussed. Locally grown annual dry biomass yields of napiergrass and leucaena, energetically equivalent to 30-50 barrels of oil per acre, are reported. Abundant local sources of waste biomass are identified. Together community waste and cultivated and waste biomass constitute a substantial source of renewable energy of use in forested and agricultural regions. Modular waste to energy systems are available in the 10-100 ton per day range. With aggressive recycling and hazardous waste reduction measures and good combustion management and emission controls, emissions should be maintained at low levels. The results from our system, a small modular waste-biomass to energy system, should be applicable to many institutions and small communities. 41 refs., 8 figs., 4 tabs.

14513 **(DOE/CE/15337—T5) [Edge illuminated ventical multijunction]: Fifth quarterly progress report, September 1, 1988--December 31, 1988.** Sater, B.L. (Sater (Bernard), Olmsted Falls, OH (USA)). 1989. Contract FG01-87CE15337. 2p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006246/JAW.

Two-dimensional computer analysis establishing optimum wafer and diffusion parameters for the wafers of the VMJ solar cell is essentially finished. The analysis of various parameters such as each diffusion depth, doping profiles and the recombiaations losses at ohmic contacts and exposed surface were studied for their sensitivity effects on overall performance. During this quarter, two other sources for diffusions were investigated. Using ion implantation processing on sample wafers we achieved a factor of two improvement in this lifetime parameter. (However, we also learned that the measurement method used may not in fact tell us what the true bulk minority-carrier lifetime really is. There are three separate regions in the pulsed conductivity lifetime measurement transient and with careful observation of the third region it appears that the bulk lifetime may be 300 microseconds.) A minority-carrier lifetime of 300 microseconds minimum should give good starting point for good cell performance.

14514 **(DOE/CH/10093—40) Photovoltaic energy program summary: Volume 1, Overview: Fiscal year 1988.** (Solar Energy Research Inst., Golden, CO (USA)). Jan 1989. Contract AC02-83CH10093. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000855/JAW.

1988 has been a year for major advances in photovoltaic (PV) technology. There has been unprecedented progress, both in the laboratory and in the industry. More technical advances. Worldwide market acceptance in new applications. If this year has been any barometer, photovoltaic energy products are rapidly moving toward the goal of supplying a part of US utility power in the 1990s. This report reviews some of the technology achievements in photovoltaics this year.

14515 **(DOE/ER/13179—2) Role of turgor pressure and solute transport in plant cell growth: Progress report.** Cosgrove, D.J. (Pennsylvania State Univ., University Park (USA). Dept. of Biology). 20 Oct 1988. Contract FG02-84ER13179. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006080/JAW.

Plant cell expansion involves simultaneous water absorption, solute uptake, and wall relaxation and synthesis. Our studies have shown that water absorption by the growing stems of pea (Pisum sativum L.) and other young seedlings is fast and is regulated primarily by wall yielding, which generates the lower water potential necessary for water absorption. Our current focus is on the nature of wall yielding, its dependence on cell turgor pressure, and the mechanism by which cell turgor is maintained in expanding cells. We have developed new relaxation methods to study wall yielding. With the pressure-probe technique we find that wall yielding in excised growing tissues is proportional to cell turgor pressure and exhibits a definite yield threshold. With the pressure-block method we can measure relaxation in intact growing tissues and find that such tissues show more complicated growth and relaxation responses than excised ones. Rapid feedback-regulation of growth is apparent from the pressure-block experiments. With these methods we have examined how drought-stress, light and growth retardants modulate stem elongation. The last two agents acts exclusively on cell wall yielding properties. With droughted pea plants, inhibition is partly through reduced cell turgor pressure and partly through reduced wall relaxation. Drought appears to alter feedback-regulation of cell expansion. Experiments are currently underway to characterize such regulation. In a related line of study we find close correspondence between rates of solute uptake from the phloem and rates of cell expansion. Work is underway to determine the nature of such coupling. 3 refs., 4 figs.

14516 **(DOE/ER/13188—5) Nitrogen control of chloroplast development: Progress report.** Schmidt, G.W. (Georgia Univ., Athens (USA). Dept. of Botany). Nov 1988. Contract FG09-84ER13188. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006642/JAW.

Our effort in the past year has resulted in completion of characterizing the major effects of nitrogen-deficiency on the accumulation of photosynthetic proteins and their mRNAs. Furthermore, we have analyzed the kinetics of recovery of cells of Chlamydomonas reinhardtii grown in nitrogen-limiting continuous cultures when ammonium is provided.

14517 **(DOE/ER/13368—5) Enzymology of acetone-butanol-isopropanol formation: Progress report, February 1, 1988--January 31, 1989.** Chen, Jiann Shin. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jan 1989. Contract FG05-85ER13368. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006290/JAW.

This project will elucidate the molecular properties of solvent-forming enzymes and to understand the mechanisms for regulating the metabolic pathway aad the expression of solvent-production genes. Our research has been carried out mostly with two strains of Clostridium beijerinckii (Clostridium butylicum). C. beijerinckii strain B593 is the more versatile one as it produces acetone, n-butanol, ethanol and isopropanol. C. beijerinckii strain B592 produces acetone, n-butanol and ethanol, but not isopropanol, which makes it similar to Clostridium acetobutylicum in product pattern. More recently, we have utilized another solvent-producing

organism, Bacillus macerans, in our enzyme studies. B. macerans is a facultative anaerobe which produces high levels of acetone and ethanol under anaerobic conditions, and it also appears to go through a metabolic switch to enter the acetone-producing stage. The metabolic pathway of B. macerans does not have the butyric acid/butanol branches which offers two advantages in our study of solvent formation: (1) it would not have two acetoacetyl CoA-reacting enzymes (3-hydroxybutyryl CoA dehydrogenase and phosphotransbutyrylase) to interfere with the study of acetoacetate-forming enzymes, and (2) it allows a study of the physiology of acetone formation without the complication of accompanying butanol formation. 4 refs., 1 fig., 1 tab.

14518 **(DOE/ER/13543—3) Soybean ribulose bisphosphate carboxylase small subunit: Mechanisms and determinants on RNA turnover: Progress report, May 1988--December 1988.** Meagher, R. (Georgia Univ., Athens (USA). Dept. of Genetics). [1989]. Contract FG09-86ER13543. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006645/JAW.

The goal of this work is to elucidate the mechanisms and determinants behind the light induced turnover and general chemical instability of Rubisco small subunit (SSU) RNA. Three approaches are being used: (A) to use molecular physiology to help define the phenomena and identify the possible cellular machinery involved in these processes; (B) SSU RNA stability will be assayed in transgenic plants; and (C) in vivo RNA structure is being examined via chemical modification of RNA. The tremendous success we have had with assaying in vivo RNA structure by DMS modification and a need to validate this technique with sufficient controls has resulted in our adding an additional goal to the project: to develop a DMS modification map of 18S rRNA and portions of Rubisco SSU RNA and predict a potential secondary structures.

14519 **(DOE/ER/13602—3) Environmental stress-mediated changes in transcriptional and translational regulation of protein synthesis in crop plants: Progress report, August 1985--August 1988.** Key, J.L. (Georgia Univ., Athens (USA)). Aug 1988. Contract FG09-86ER13602. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006477/JAW.

Research during the current grant period included isolation and characterization of a number of HS-related cDNAs and genomic clones; this activity included the sequencing of two genomic clones of the 13-member pCE53 family of genes, one of the pFS2033 family, one of the hsp70 family, partial sequences of three genomic clones of the pEV set of clones, and corresponding cDNAs to these genomic clones. Additional clones related to the hsp83 family were isolated from both soybean and Arabidopsis and partially characterized. Considerable effort has gone into attempts to isolate clones to the hsp90 and 110 families; while promising results were obtained, no definitive data are available on clone identity. This information provides a data base of HS genes that will be exceedingly useful in planned experiments as well as important information on the complexity and relationships of hsp families in plants. HS promoter cassettes were developed using the Gmhsp17.5-E clone (pFS2019cDNA); the promoter of this gene was extensively characterized by Czarnecka and Gurley. This promoter cassette was used to analyze the expression of a number of genes in transient assays using isolated protoplasts, with β-1,3 glucanase (GUS) proving to be a very useful reporter gene. Perfect fusions proved to provide higher levels of expression of GUS than the array of non-perfect fusions tested. This system provides a very efficient and useful assay for different promoter/gene constructs prior to using them in transformation/transgenic plant analyses. The utility of the cassette was demonstrated by studies on expression of the isopentenyltransferase gene from T-DNA in transgenic tobacco plants.

14520 **(DOE/ER/13631—12) Mechanisms of phtotchemical energy conversion by chlorophyll: Progress report, 1 July 1986--28 February 1989.** Tollin, G. (Arizona Univ., Tucson (USA). Dept. of Biochemistry). 28 Feb 1989. Contract FG02-86ER13631. 13p. NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89006820/JAW.

Large and small unilamellar vesicles have been compared with respect to chlorophyll triplet quenching and electron transfer occurring at the inner and outer bilayer surfaces. Unexpectedly, large vesicles display inside-outside asymmetry, which is reversed in direction from that of small vesicles, indicating that factors in addition to lipid packing density asymmetry are responsible for the asymmetric behavior. Varying the ionic strength of the medium and the surface charge suggests that a transmembrane potential, in which the exterior surface is more negative than the interior, is also involved in causing asymmetry. Experiments using valinomycin indicate that ionophores, by generating electrostatic effects within the bilayer, exert more selective effects on membrane photochemical processes than do charges on the membrane surface. 3 refs.

14521 **(DOE/ER/13713—T1) [The genetics and molecular biology of hydrogen metabolism in sulfate-reducing bacteria]: Progress report.** (Missouri Univ., Columbia (USA). Dept. of Biochemistry). Dec 1988. Contract FG02-87ER13713. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007149/JAW.

In anaerobic digestors and natural environments, the sulfate-reducing bacteria (SRB) play a pivotal role in methane generation, either providing hydrogen and acetate for methane formation or competing with the methanogens for those same substrates. The SRB are also the primary culprits in causing environmental metal corrosion costing millions of dollars each year and in producing poisonous sulfide sometimes costing lives. Key factors controlling the interactions of the SRB with other microorganisms in their environment are hydrogen metabolism and their tolerance of exposures to oxygen. The number of enzymes capable of producing or consuming hydrogen in the SRB and their physiological functions remain obscure. Our laboratory is developing the genetics and molecular biology of the SRB with the aim of examining the hydrogen metabolism. Desulfovibrio desulfuricans ATCC 27774 has been found to be amenable to classical genetic manipulation, antibiotic resistant mutants as well as mutants altered in sulfate and hydrogen metabolism have been isolated. Most excitingly, this strain has been found to produce a defective bacteriophage capable of generalized transduction. This strain as well as G100A have been found to be capable of genetic exchange with Escherichia coli via conjugation involving Q-incompatibility group plasmids. Detailed examination of the metabolic properties of these bacteria is now possible.

14522 **(DOE/EV/00637—17) Development of innovative techniques and principles that may be used as models to improve plant performance: Technical progress report, February 1, 1988--January 31, 1989.** Hanna, W.W. (Georgia Univ., Athens (USA). Boyd Graduate Studies Research Center). Sep 1988. Contract AS09-76EV00637. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006287/JAW.

We propose to help develop innovative techniques to improve plant performance. Cytoplasms from wild Pennisetum species have been identified that affect forage yields, days to anthesis, head length, seed weight, and cytoplasmic-genic male sterility (cms). A number of new cytoplasms for cms are being identified. The A' genome from the secondary gene pool in Pennisetum is proving to be a valuable source of genes that can be rapidly used to improve cultivated pearl millet. The discovery and use of this germplasm may have a significant impact on developing pearl millet as a new drought tolerant grain crop for the US. Significant progress is being made in transferring gene(s) controlling apomixis from wild P. squamulatum to cultivated pearl millet for the purpose of producing true-breeding hybrids. 27 refs.

14523 **(E/CFS—LAV-X-45E) Evaluation of potential impacts of forest biomass harvesting.** (Department of the Environment, Ottawa, Ontario (Canada). Canadian Forestry Service). 1980. 57p. (MICROLOG—82-1657; CE—02198). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The principal objective of this study entails the identification of the variables pertaining to the forest environment that are most susceptible to being influenced by biomass harvesting. A comprehensive approach is developed, including a literature search and the use of correlative matrices as an aid in facilitiating the identification

of the impacts which affect certain environmental variables, and which result from specific activities related to forest logging. Primary impacts of biomass harvesting on climate, water, soil, wildlife and vegetation are described. Several secondary impacts are then associated with these primary impacts. Interrelations between harvesting operations, primary and secondary impacts are then analyzed with the mastrices. A global flow chart of interrelations is also constructed. A number of mitigative measures are suggested and applied to the principal themes or areas, namely: roads and trails; utilization of residues; choice of harvesting season; and the cutting cycle. Several specific flow diagrams are proposed for the different forest resources, which identify the variables from which the major negative impacts are taken and which thus should be controlled first. Strategies, program design, and relevant variables are outlined for the monitoring potential impacts resulting from biomass harvesting. Includes 3 folded charts in pocket. 18 figs.

14524 (EMR—ER80-8F, pp 34-42) **Practical applications of natural processes for organic waste conversion.** Benoit, F.W. (Geobi Inc., Candiac, Que.). 1980. (In French). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

A system for the anaerobic digestion of agricultural or municipal wastes into methane and carbon dioxide, resulting in a liquid residue which serves as a protein source and a fertilizer, is outlined in this report. Experiences with the system at two operating sites is briefly described. Typical performance figures and the basic bioreactor design are also presented. 4 figs.

14525 (EMR—ER80-8F, pp 12-34) **Biomass.** Simard, F.-X. (Energy, Mines and Resources Canada). 1980. (In French). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

Recent developments in converting biomass to useful energy are presented, with special mention on how these can be applied in Canada. Biomass resources, and how they are used, are outlined under the categories of wood, grains and agricultural wastes, peat, municipal wastes, and sewage or manures. Conversion techniques enumerated in this paper include combustion, gasification, liquefaction, pyrolysis, biodigestion and recycling. Methanol is highlighted as a fuel for the future, with production in Canada being possible through new processes using wood. A number of public programs for promoting biomass conversion are described. In the USA, these include financial incentives for use of biomass-derived fuels and for constructing alcohol fuel plants. In Brazil, alcohol derived from biomass is a major component of the national fuel supply. In Canada, three federal programs are noted: the ERIF program for renewable energy in the forest industry; loan guarantees for exploitation of biomass energy; and the ENFOR forest energy program. In Quebec, provincial policy is to reduce oil imports, and renewable energy may play a part in fuel substitution. The overall conclusion is that biomass energy offers great potential for replacing petroleum as an energy source. 14 refs., 1 fig.

14526 (EMR—ER80-8F) **Biomass energy.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1980. 160p. (In French). (CONF-8004250—; MICROLOG—82-3707; CE—02117). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

A seminar on biomass energy in Canada was held to create greater awareness among people directly involved with this area of activity, and to increase interest in this subject among the general public. Papers were presented on the products obtainable from biomass, conversion of organic wastes, production of ethanol fuels, the use of alcohol fuels, wood-waste boilers, the use of peat as an energy source, development of cybernetic technology, and the future of biomass as an energy source. Separate abstracts have been prepared for seven papers from this seminar.

14527 (IAEA-TECDOC—475) **Improved biomass utilization through the use of nuclear techniques. Report of the final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques held in Ljubljana, Yugoslavia, 11-14 May 1987.** (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). Oct 1988. 114p. (CONF-8705360—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW.

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

Biomass is a major by-product resource of agriculture and food manufacturing, but it is under-utilized as a source of food, fibre, and chemicals. Nuclear techniques provide unique tools for studies of the capabilities of micro-organisms in methane digestor operation and in the transformation of lignocellulosic materials to useful products. Nuclear techniques have also been effectively employed as mutagenic agents in the preparation of more efficient microbial strains for the conversion of biomass. This report reviews the variety and diversity of such applications with focus on the development of microbial processes to utilize agricultural wastes and by-products. The value of nuclear techniques is manifestly demonstrated in the production of efficient microbial mutant strains, in the tracing of metabolic pathways, in the monitoring of lignin degradation and also of fermenter operation. Refs, figs and tabs.

14528 (IAEA-TECDOC—475, pp 9-16) **Volatile organic acid turnover in anaerobic digestion.** Boone, D.R. (California Univ., Los Angeles (USA)). Oct 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW. (CONF-8705360—).

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

Rate-limiting reactions of anaerobic digestors were demonstrated to be hydrolytic reactions or methanogenic reactions, depending on operational factors. Normally, the extent of polymer hydrolysis limits the quantity of methane formed because hydrolysis products are stoichiometrically converted to methane. We studied several anaerobic, cellulolytic bacteria and report their characteristics. We also found that methanogenic and associated syntrophic populations grow more slowly than cellulolytic and fermentative organisms, so operational parameters must be manipulated to maintain these bacteria as thriving populations; otherwise methanogenesis will cease. We developed techniques for measuring turnover of volatile fatty acids, the principal substrates for this group of organisms, in anaerobic digestors. These include tracer methods for measurement of volatile organic acid turnover when the concentrations of those acids are not constant. We also demonstrated that propionate turnover should be measured with methylene- or methyl-labeled propionate rather than carboxyl-labeled propionate. (author). 41 refs.

14529 (IAEA-TECDOC—475, pp 25-37) **Purification and characterization of cellulolytic enzymes from Aspergillus ustus M35 and trichoderma harzianum M5.** Macris, B.; Paspaliari-Palaiodimopoulou, M. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Oct 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW. (CONF-8705360—).

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

A number of methods were applied in an effort to purify the cellulolytic enzymes of Aspergillus ustus M35 and Trichoderma harzianum M5. These mutants were induced by gamma radiation and excreted elevated levels of cellulase and β-glucosidase when grown on different cellulosic substrates. Acetone and ammonium sulfate precipitation, high performance liquid chromatography and ion exchange chromatography were applied. The latter method

gave the best results and involved the use of anion exchange resins Accell QMA, Mono Q and Sepharose Q. Mono Q was part of a fast protein liquid chromatography apparatus. The application of Accell QMA revealed the existence of at least two carboxymethylcellulase, two β-glucosidase and one cellobiohydrolase forms in both mutants. Purification of A. ustus M35 with Sepharose Q resulted in the isolation of two β-glucosidase, one carboxymethylcellulase and a mixture of cellulase and β-glucosidase forms. Further purification of the mixture with Mono Q resulted in the isolation of one cellobiohydrolase form. Certain kinetic characteristics of A. ustus M35 purified enzymic forms showed optimum pH values at 3.8, 4.2 and 5.0 for CMCase and β-glucosidase I and II forms respectively. The respective temperature optima were 65, 65 and 45 deg. C. Further purification of cellulolytic systems of both mutants is under investigation. (author). 12 refs, 7 figs, 2 tabs.

14530 (IAEA-TECDOC—475, pp 39-51) **Selection of mutants of Cellulomonas biazotea for improved cellulolysis.** Rajoka, M.I.; Bashir, A.; Malik, K.A. (Nuclear Inst. for Agriculture and Biology, Faisalabad (Pakistan)). Oct 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW. (CONF-8705360—).

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

Two hypersecreting cellulolytic mutants (51Str/sup r/ and 7Rf/sup r/) of Cellulomonas biazotea NIAB 442 showing large blackening zones on esculin-ferric-ammonium citrate agar plates were isolated after gamma ray-induced mutagenesis. The mutants showed 2.2 times enhanced production of beta-D-glucoside glucohydrolase (beta-glucosidase EC 3.2.1.21) and beta-xylosidase (EC 3.2.1.37). The activity of endo-1,4-beta-D-glucanase (CMCase EC 3.2.1.4) was marginally altered. Subsequent chemical mutagenesis (nitrosomethyl urea (NMU), ethyl methane sulphonate (EMS) or 1-methyl-3-nitro-1-nitrosoguanidine (MNNG)) yielded a variety of further mutants, EMS being the most effective mutagen. Mutants from EMS included a one copper resistant mutant (Cu-1), penicillin resistant mutant (AVIS) and several constitutive mutants for hypersecretion of beta-glucosidase, from NMU a hypersecreting mutant (M-NMUI with 2.7-3 fold increase in beta-glucosidase and beta-xylosidase) and also a hypersecretive mutant (BG-4) which also hyperproduced (5 fold) beta-glucosidase and beta-xylosidase (2.8 fold) by using MNNG. The mutants showed improved saccharification of Leptochloa fusca (L) Kunth (Kallar grass). (author). 12 refs, 6 figs, 6 tabs.

14531 (IAEA-TECDOC—475, pp 53-69) **Gamma and MNNG mutants for bioconversion of apple distillery waste.** Cimerman, A.; Gunde-Cimerman, N.; Perdih, A. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia); Edvard Kardelj Univ., Ljubljana (Yugoslavia). Dept. of Chemistry and Chemical Technology). Oct 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW. (CONF-8705360—).

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

The mutation of Aspergillus niger by gamma irradiation and MNNG treatment for gaining hyperenzyme producing strains was continued. Potentially useful mutants were evaluated in fermentation tests for enhanced hydrolytic activities and also improved technological properties e.g. improved filtration. Enhanced cellulase activities (endoglucanase, FP activity, aryl-beta-glucosidase) were found. Amylolytic and pectolytic activities also increased. Trichoderma sp. was mutated by gamma rays and MNNG. Mutants were screened for their cellulolytic activities and more active mutants tested in fermentation tests. The selected A. niger and Trichoderma sp. mutants were used together in mixed culture and certain improvements of the bioconversion of apple distillery waste gained. (author). 17 refs, 3 figs, 6 tabs.

14532 (IAEA-TECDOC—475, pp 71-83) **Delignification of lignocellulosics and decolorization of Kraft Mill effluent via Pleurotus sp. mutant PL/sub 3/-M/sub 6/.** Kolankaya, N.; Saglam, N.; Cansunar, E. (Hacettepe Univ., Ankara (Turkey). Dept. of General Biology). Oct 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705333/JAW. (CONF-8705360—).

From Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques; Ljubljana, Yugoslavia (11 May 1987).

A mutant P1/sub 3/-M/sub 6/, derived from the wild isolate Pleurotus sp. (P1/sub 3/) by irradiation treatment was selected based on its high peroxidase and low cellulase activity. It was more effective than the wild strain in the delignification of woody materials (beech, pine and poplar tree). Growth of P1/sub 3/-M/sub 6/ on barley straw increased the digestibility of this lignocellulosic substrate. Furthermore, P1/sub 3/-M/sub 6/ was more effective in decolorizing black kraft mill effluent than the parent strain. It is also of interest that the xylanase activity of the mutant is much greater than of the parent strain. 17 refs, 10 figs, 2 tabs.

14533 **(N—89-12123) InP homojunction solar cell performance on the LIPS 3 flight experiment.** Brinker, D.J.; Hart, R.E. Jr.; Weinberg, I.; Smith, B.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 11p. (NASA-TM—101390; E—4454; NAS—1.15:101390; CONF-880965—). NTIS, PC A03/MF A01.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

Performance data for the NASA Lewis Research Center indium phosphide n+p homojunction solar cell module on the LIPS 3 Flight Experiment is presented. The objective of the experiment is to measure the performance of InP cells in the natural radiation environment of the 1100 km altitude, 60+ deg inclination orbit. Analysis of flight data indicates that the performance of the four cells throughout the first year is near expected values. No degradation in short-circuit current was seen, as was expected from radiation tolerance studies of similar cells. Details of the cell structure and flight module design are discussed. The results of the temperature dependency and radiation tolerance studies necessary for normalization and analysis of the data are included.

14534 **(N—89-12819) Radiation resistance and comparative performance of ITO/InP and n/p InP homojunction solar cells.** Weinberg, I.; Swartz, C.K.; Hart, R.E. Jr.; Coutts, T.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1988. 11p. (NASA-TM—101387; E—4447; NAS—1.15:101387; CONF-880965—). NTIS, PC A03/MF A01.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

The radiation resistance of ITO/InP cells processed by DC magnetron sputtering is compared to that of standard n/p InP and GaAs homojunction cells. After 20 MeV proton irradiations, it is found that the radiation resistance of the present ITO/InP cell is comparable to that of the n/p homojunction InP cell and that both InP cell types have radiation resistance significantly greater than GaAs. The relatively lower radiation resistance, observed at higher fluence, for the InP cell with the deepest junction depth, is attributed to losses in the cells emitter region. Diode parameters obtained from I sub sc - V sub oc plots, data from surface Raman spectroscopy, and determinations of surface conductivity types are used to investigate the configuration of the ITO/InP cells. It is concluded that thesee latter cells are n/p homojunctions, the n-region consisting of a disordered layer at the oxide semiconductor.

14535 **(NA—8111) Integrated logging for production of pulpwood and hog fuel.** Wilton, W.C. (Northland Associates Ltd., St. John's, Newfoundland (Canada)). 1981. 46p. (CE—02199). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents results of operational trials of an integrated harvesting system for producing pulpwood, sawlogs and hog fuel in Newfoundland. Objectives of the trials included technical,

economic and environmental assessment, and determination of the best combination of harvesting techniques and utilization standards which would give the greatest economic return. Three trials were completed: a salvage operation harvesting standing hardwood biomass and pulpwood debris; an integrated full-tree operation; and a salvage operation harvesting hardwoods from a mixedwood cutover in combination with biomass from adjacent hardwood stands. Results show that the overall trial to produce hog fuel was conducted at a loss, due to adverse weather; under normal conditions, it would have been profitable. In the individual harvesting trials, the first one was the least successful and the third resulted in the least loss. The second (integrated) trial also resulted in an apparent loss; however, when the results of the last 2 trials are corrected for the differences in moisture content between the harvest and the hog fuel burning test, these trials can be said to have at least broken even. The environmental impact portion of the study developed into an analysis of the effect of biomass harvesting on a mixedwood cutover area. Salvage of residual biomass, within 3 y of normal pulpwood harvesting, was shown to result in no excessive damage to the growing site or to forest reproduction. Biomass harvesting means better utilization, reduction of fire hazards, and improved aesthetic appearance; removal of residual hardwoods and logging debris also prepare the site for any future silvicultural treatments. 8 refs., 5 figs., 8 tabs.

14536 **(OY/PSTL-TIED—53) Possibilities of contractional small wood harvesting on forestry sites.** Ahonen, A.; Kiukaanniemi, E.; Karjalainen, T. (Oulu Univ. (Finland). Research Inst. of Northern Finland). Aug 1988. 48p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756290/JAW.

This report deals with small wood harvesting possibilities on forestry sites. In addition to harvesting of small wood, the present of forestry and the possibilities of fuel and industrial uses of small wood have also been reviewed. Also the effects of efficient forestry on employment has been viewed. The costs of smallwood harvested as forest chips from the sapling sites on the site are 350-400 FIM/m/sup 3/. When the caretaking fee of plants are taken into account the costs will go down to 189-227 FIM/m/sup 3/. The costs in first thinning and clear felling sites are 165-193 FIM/m/sup 3/. Forest chips are hence not competitive with heawy fuel oil as the fuel of heating plants. According to the investigations the acquisition of forest chips seem to be competitive in certain separate sites suitable for contract based chipping. The problems of harvesting of small wood coming from forestry are the expensiveness of harvesting and the lack of consumers. If these problems can be solved the contractional harvesting of small wood may be a mean for forest owners to increase the efficiency of forestry.

14537 **(SAND—88-7040) Dendritic web silicon photovoltaic cell research.** Seidensticker, R.G.; McHugh, J.P.; Hopkins, R.H.; Meier, D.L.; Spitznagel, J.A.; Lein, S.Y. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Jan 1989. Contract AC04-76DP00789. 104p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007289/JAW.

This report summarizes a program for which the overall goal was improving the understanding of the material and device factors that limit the performance of solar cells fabricated from dendritic web silicon. An analytical model for crystal defect generation was developed, starting with the temperature distribution in the growing crystal and continuing through the effect of thermal stress on defect structures observed in dendritic web crystals grown in carefully characterized thermal conditions. Good agreement exists between the model and experiment. The origin of dislocations in the silicon web was discrete sources, probably freezing silicon droplets, in the bounding dendrites; these sources can be eliminated by localized heating with a laser during the growth process. Thermal stresses farther from the growth front can be controlled by a thermal modifier designed to reduce buckling of the web crystal and the concommitant dislocation generation. These crystal defects were correlated with solar cell performance by fabricating devices on well-characterized web material and correlating performance with residual stress. Low-stress, high-perfection material was conducive to high-quality cells; high-stress material led to poorer cells with a yield characteristic depending on the sign of the stress. The mechanism by which dislocations degrade cell quality was not completely identified but appears due to dislocation-impurity interactions. For example, antimony-doped material yields better cells than phosphorus-doped material. 18 refs., 35 figs., 14 tabs.

14538 **(SERI/STR—211-3373) Research on high-efficiency, multi-gap, multijunction, amorphous-silicon-based alloy thin-film solar cells: Phase I annual subcontract report, 1 March 1987--29 February 1988.** Guha, S. (Solar Energy Research Inst., Golden, CO (USA); Energy Conversion Devices, Inc., Troy, MI (USA)). Aug 1988. Contract AC02-83CH10093. 121p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000845/JAW.

This report describes the first year of progress in research directed toward material development, single-junction solar cell research, and deployment of high-efficiency multijunction solar cells prepared of alloys of amorphous silicon. High-quality a-SiGe alloys were made with a band gap of 1.4 eV. Incorporation of this material in tandem and triple-junction cells resulted in the world's highest efficiency a-Si based alloy thin-film solar cells to date. Efficiencies of 12.7% for dual-gap tandem and 13.6% for dual-gap triple cells were measured under global AM1.5 illumination at 25{degree}C. Further optimization of materials and device designs should result in efficiencies of about 15% during Phase II of the program. 21 refs., 51 figs., 19 tabs.

14539 **(SERI/STR—211-3408) Research on high-efficiency, single-junction, monolithic, thin-film amorphous silicon solar cells: Phase II annual subcontract report, 1 January 1985--31 January 1986.** Carlson, D.E.; Ayra, R.R.; Bennett, M.S.; Catalano, A.; D'Aiello, R.V.; Dickson, C.R.; McVeigh, J.; Newton, J.; O'Dowd, J.; Oswald, R.S.; Rajan, K. (Solar Energy Research Inst., Golden, CO (USA); Solarex Corp., Newtown, PA (USA). Thin Film Div.). Sep 1988. Contract AC02-83CH10093. 137p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000849/JAW.

This report presents results of the second phase of research on high-efficiency, single-junction, monolithic, thin-film a-Si solar cells. Five glow-discharge deposition systems, including a new in-line, multichamber system, were used to grow both doped and undoped a-Si:H. A large number of silane and disilane gas cylinders were analyzed with a gas chromatography/mass spectroscopy system. Strong correlations were found between the breakdown voltage, the deposition rate, the diffusion length, and the conversion efficiency for varying cathode-anode separations in a DC glow-discharge deposition mode. Tin oxide films were grown by chemical vapor deposition with either tetramethyl tin (TMT) or tin tetrachloride (TTC). The best were grown with TMT, but TTC films had a more controlled texture for light trapping and provided a better contact to the p-layer. The best results were obtained with 7059 glass substrates. Efficiencies as high as 10.86% were obtained in p-i-n cells with superlattice p-layers and as high as 10.74% in cells with both superlattice p- and n-layers. Measurements showed that the boron-doping level in the p-layer can strongly affect transport in the i-layer, which can be minimized by reactive flushing before i-layer deposition. Stability of a-Si:H cells is improved by light doping. 51 refs., 64 figs., 21 tabs.

14540 **(SERI/STR—211-3409) Research on high-efficiency, single-junction, monolithic, thin-film amorphous silicon solar cells: Phase III semiannual subcontractor report, 1 February 1986--31 July 1986.** Carlson, D.E.; Ayra, R.R.; Bennett, M.S.; Catalano, A.W.; D'Aiello, R.V.; Dickson, C.R.; Newton, J.L.; Oswald, R.S. (Solar Energy Research Inst., Golden, CO (USA); Solarex Corp., Newtown, PA (USA). Thin Film Div.). Sep 1988. Contract AC02-83CH10093. 101p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000848/JAW.

This report presents results of the third phase of research on high-efficiency, single-junction, monolithic, thin-film a-Si solar cells. Six glow-discharge deposition systems, including an in-line, multichamber system, were used to grow both doped and undoped a-Si films. In single load-lock systems, a-Si was deposited over 1000-cm^2 substrates with less than a 1% variation in thickness and low oxygen impurity levels. The system produced 1000-cm^2 submodules with active-area efficiencies of 8.7%. Textured tin oxide films were

grown by chemical vapor deposition using tin tetrachloride. The quantum efficiency of p-i-n devices at 700 nm increases as the scattering in the tin oxide increases. Solar cells with 10-11% efficiencies were obtained using superlattice p- and n-layers in p-i-n structures. Fill factors as high as 0.771 were obtained with carbon grading at the p/i interface. A model for the annealing process was developed based on the random walk motion of mobile hydrogen. Submodules were produced with total-area efficiencies as high as 7.4%. The multichamber deposition system used to fabricate p-i-n cells was overhauled to improve the heating and the pumping systems. 21 refs., 41 figs., 21 tabs.

14541 **(SFU/DC—7901) A device for electrochemical storage of photon energy. Final report.** Funt, B.L. (Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Chemistry). 1979. 30p. (CE—02243). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A major objective of this research was to investigate and optimize the conditions for preparing electrodeposited CdSe photoelectrodes for photoelectrochemical cells. An optimal composition for the deposition bath was determined experimentally. Deposition potential limits were defined by voltammograms, and CdSe was deposited on Ni substrates at voltages chosen to span the range indicated by these limits. Each electrode was then tested in a photoelectrochemical cell; the photopotential span of the electrodes ranged from 0.22 to 0.26 V, and the photocurrent span from 10 to 20 mA. Red Se deposits were observed if deposition times were too long. CdSe was also deposited by passing a constant current between a Ni working electrode and a Pt counter electrode, with the object of initiating deposition at a convenient potential while maintainig a constant current. It was found that heating the electrodes at 400/sup 0/C for 15 min in a nitrogen atmosphere improves the short circuit currents by up to 400% and the open circuit potentials by 50%. Mott-Schottky plots for several photoelectrodes were obtained; data indicated current leakage which increased at higher potentials, suggesting that shorting between electrolyte and Ni substrate occurs. Photoelectrochemical cells were fabricated, both with and without storage, and tentative trials were made of photoelectrodes deposited on a mesh substrate. This research has demonstrated that working photoelectrodes, with consistent performance characteristics, can be prepared by a relatively simple process. Nonetheless, improvements in performance have not been dramatic, and reasons for limitations in efficiency are discussed. 4 refs., 11 figs.

14542 **(STEV-EO—88-9) Growth and energy yield when cultivating various energy crops on farming soil.** Thoerner, L. (Malmoehus laens Hushaallningssaellskap, Bjaerred (SE)). (Statens Energiverk, Stockholm (Sweden)). Mar 1988. 54p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756295/JAW.

In four fields in the south of Sweden different energy crops were tested. In all trials sugar beet, barley, alfalfa, corn, sunflower and quickgrowing species of Salix (energy forest) were grown. In some of the trials broome-grass, potatoes and winter wheat were tested. One trial also included marrow-stem kale, Jerusalem artichoke and a hybride of J artichoke and sunflower. The purpose of the experiment was to illustrate the effect of increasing N-fertilizing and the effect of growing the crops in different climatic conditions. The yield varies between the crops. Some of the crops were harvested in different stages of development. The largest yields were noticed for sugar beet, corn, potatoes and energy forest. For these crops the yield was 11.5-14.5 tons of dry matter per hectare. The yield of potatoes was very large but it is figures for only one place with very good conditions. Barley, sunflower and alfalfa produced 8-10 tons of dry matter per hectare. The smaller yield depends on a short vegetation season for these crops. The year of establishment the energy forest produced about four tons of dry matter in the form of stem wood. When fully established the production has been 12-15 tons of dry matter per hectare and annum. The analysis of plant material indicates small divergences in the content of carbon and heat value.

14543 **(VTT-TUTK—558) Photovoltaic module performance in Finland, part 2.** Nyman, C.; Leppihalme, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Puolijohdelaboratorio). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1988. 93p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756317/JAW.

Research on the evolution of photovoltaic module performance in Finnish climatic conditions has been undertaken at two different locations in Finland. The aim of this research was to compare different photovoltaic materials. The difference in energy output per square meter between crystalline and monocrystalline silicon modules is that crystalline silicon has a greater energy output when the sun is low (in winter, mornings and evenings). The amorphous silicon modules show a poor efficiency of 3% throughout the year. The increase in energy output in summer and winter is about 10%, by using bifacial photovoltaic modules. By using the same module at two different tilt angles, 90 deg C tilt in winter and 60 deg tilt in summer (April-August) the increase of energy output is 7% Otaniemi (60 deg N). The increase at Pyhaetunturi (67 deg N) is about 10%. The insolation at Pyhaetunturi test station was high as early as February. This means that the use of photovoltaic systems in Lapland is possible in winter by dimensioning the storage capacity to carry the system over the dark winter period. Energy production begins in February and may then have high density becayse of the reflections from snow.

14544 **Application of isothermal current deep level transient spectroscopy to solar cells.** Rancour, D.P.; Pierret, R.F.; Lundstrom, M.S.; Melloch, M.R. (School of Electrical Engineering, Purdue University, West Lafayette, Indiana 47907). *Journal of Applied Physics;* **65**: No. 5, 2173-2176(1 Mar 1989).

The utility of isothermal current deep level transient spectroscopy (DLTS) techniques in directly probing solar cells is described and illustrated. A modified approach to processing the isothermal DLTS data is also presented. Specifically, it is pointed out that properly normalized isothermal data, whether derived from a current or capacitance transient, should conform to a single, temperature-independent curve.

14545 **Long-wavelength infrared detectors based on strained InAs—Ga/sub 1-//sub x/In/sub x/Sb type-II superlattices.** Mailhiot, C.; Smith, D.L. (Xerox Webster Research Center, Webster, New York 14580). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 2, 445-449(Mar 1989).

We demonstrate that infrared detectors made from strained type-II superlattices consisting of III—V semiconductors can have favorable properties for long-wavelength (λ/sub c/ >10 μm) detection applications. We specifically consider InAs—Ga/sub 1-// sub x/ In/sub x/ Sb strained-layer superlattices with $x \geq 0.4$. This is a type-II superlattice where the conduction-band minimum of InAs is lower in energy than the valence-band maximum of Ga/sub 1-// sub x/ In/sub x/ Sb. Electrons are localized in the InAs layers while holes are localized in the Ga/sub 1-//sub x/ In/sub x/ Sb layers. Generally, in a type-II superlattice such as InAs—GaSb, large absorption coefficients cannot be achieved at the small values of band gap necessary for long-wavelength detection because the localization of electrons and holes in adjacent layers leads to small optical matrix elements. Therefore, small band gaps and large optical matrix elements appear to be two mutually exclusive requirements in the InAs—GaSb superlattice. Here, we show that it is possible to obtain large optical absorption coefficients at the values of band gap required for long-wavelength detection by taking advantage of internal lattice-mismatch induced strains present in InAs—Ga/sub 1-//sub x/ In/sub x/ Sb superlattices.

14546 **The issue of harmonic injection from utility integrated photovoltaic systems. Part 2. Study results.** Stevens, J. (Sandia National Labs., Albuquerque, NM (US));. *IEEE Transactions on Power Electronics;* **3**: No. 3, 511-515(Sep 1988).

Harmonic injection is a growing concern to electric utility companies. One potential source of harmonics is utility intertied

photovoltaic (PV) systems. This paper summarizes the results of several research efforts investigating harmonics injected by PV systems. These efforts indicate that harmonic injection from photovoltaic systems, while it can't be ignored, is no more a problem than the harmonic injection from several commonly used household appliances.

14547 **Influence of perimeter recombination on high-efficiency GaAs p/n heteroface solar cells.** De Moulin, P.D.; Lundstrom, M.S.; Carpenter, M.S.; Melloch, M.R. (School of Electrical Engineering, Purdue Univ., West Lafayette, IN (US)); Tobin, S.P. (Spire Corp., Bedford, MA (US));. *IEEE Electron Device Letters;* 9: No. 8, 368-370(Aug 1988).

Perimeter recombination currents have been characterized for 0.5 x 0.5- and 2 x 2-cm/sup 2/ p/n GaAs solar cells. Measurements show that perimeter recombination dominates the n = 2 dark current component of these high-efficiency solar cells. The results also suggest that perimeter recombination will be substantial even in much larger area solar cells. Although little influence on open-circuit voltage is expected, perimeter recombination may adversely affect the cell's one-sun fill factor. Because of its importance to one-sun applications, recombination at the junction perimeter must be suppressed before GaAs solar cells approach their limiting conversion efficiencies.

14548 **Copper photoelectroplating using a n-CuInSe/sub 2//acidic iodide based cell.** Menezes, S. (Rockwell International Science Center, Thousand Oaks, CA (US));. *Journal of the Electrochemical Society;* 135: No. 7, 1854(Jul 1988).

This communication describes a novel method to electroplate Cu in a solar cell while generating electrical energy. The method is based on controlling the redox equilibria between the Cu/sup +/++/ and the I/sup -//I/sub 2/ couples, so that I/sup -/ is photooxidized at CuInSe/sub 2/ photoanode while Cu/sup ++/ is reduced at a metal (the substrate to be plated) cathode. The CuInSe/sub 2//electrolyte interface has been primarily investigated for photoelectrochemical (PEC) conversion of solar energy. Rigorous control of interface reactions allows an energy conversion efficiency of 12.2% for the CuInSe/sub 2//I/sup -/-I/sub 2/-CuI-HI cell with virtually total stability. Further, the extreme sensitive of the CuInSe/sub 2/ surface to the electrochemical environment was advantageously used to generate a series of semiconducting compounds, including two potential window materials, CuISe/sub 3/ and CuIn/sub 2/ISe/sub 3/.

14549 **The photovoltaic advanced systems test facility.** Chamberlin, J.L. (Sandia National Labs., Albuquerque, NM (USA)). pp 58-63 of Eighth E.C. photovoltaic solar energy conference. Volume 1. Solomon, I.; Equer, B.; Helm, P. (eds.). Dordrecht, Netherlands; Kluwer Academic Publishers (1988). (CONF-880513—).

From 8. European photovoltaic solar energy conference; Florence, Italy (9 May 1988).

Sandia National Laboratories, as part of the United States Department of Energy's (DOE) National Photovoltaics (PV) Program, operates an extensive PV testing laboratory in Albuquerque, New Mexico. The objectives of this laboratory, the Photovoltaic Advanced System Test Facility (PASTF), are to assess the performance of PV and balance-of-systems (BOS) hardware and to work with their developers to rectify any performance deficiencies found. The principal resources of the PASTF consist of a materials testing laboratory, a lens and lens/cell testing facility, a module testing facility, an array testing facility, a power conditioner evaluation facility, and specialized test stations for evaluation of BOS hardware. A cell characterization laboratory that is part of the larger Sandia PV effort provides evaluational support in this area. These resources are augmented by Sandia's extensive research and support facilities, principally in the areas of material characterization and environmental testing. The resources of the PASTF along with examples of their application to the evaluation of PV hardware are described. 4 refs.

14550 **Calibration of primary terrestrial reference cells when compared with primary AMO reference cells.** Emery, K.A.; Osterwald, C.R.; Kamerski, L.L.; Hart, R.E. (Solar Energy Research Institute, Golden, CO (USA)). pp 64-68 of Eighth E.C. photovoltaic solar energy conference. Volume 1. Solomon, I.; Equer, B.; Helm, P. (eds.). Dordrecht, Netherlands; Kluwer Academic Publishers (1988). (CONF-880513—).

From 8. European photovoltaic solar energy conference; Florence, Italy (9 May 1988).

The method used at SERI to calibrate primary terrestrial reference cells should be valid for any tabular reference spectral irradiance. The results are reported of a comparison between primary AMO reference cells calibrated using high altitude aircraft by NASA Lewis and primary terrestrial reference cells calibrated outdoors by SERI. The comparison showed a maximum difference of 1.5% between the primary AMO value and the short-circuit current measured in the laboratory using spectral mismatch corrections and a primary terrestrial reference cell. The comparison involved 9 different primary AMO reference cells and 8 different primary terrestrial reference cells. The agreement is within the estimated approx. 1% uncertainty for primary AMO and primary terrestrial reference cell calibrations and well within the estimated approx. 2% uncertainty for simulator based measurements at SERI. 4 figs., 11 refs., 2 tabs.

14551 **Efficient thin silicon-film solar cells on low cost substrates.** Barnett, A.M.; Rand, J.A.; Domian, F.A.; Ford, D.H.; Kendall, C.L.; Rock, M.L.; Hall, R.B. (Delaware Univ., Newark (USA)). pp 149-155 of Eighth E.C. photovoltaic solar energy conference. Volume 1. Solomon, I.; Equer, B.; Helm, P. (eds.). Dordrecht, Netherlands; Kluwer Academic Publishers (1988). (CONF-880513—).

From 8. European photovoltaic solar energy conference; Florence, Italy (9 May 1988).

Thin polycrystalline Silicon-Film solar cells are being developed on low cost ceramic substrates. One square centimeter solar cells with energy conversion efficiencies of 14.2 percent have been demonstrated. The Silicon-Film solar cell design is based on light trapping which leads to increases in the voltage, current and efficiency when compared to thick polycrystalline silicon solar cells. The light-trapping design models indicate that efficiencies in excess of 19 percent can be achieved. 8 figs., 7 refs., 3 tabs.

14552 **Polypyrrole-PEO . LiCF/sub 3/SO/sub 3/ composites formed by in situ pulsed potentiostatic electropolymerization.** Harris, C.S.; Odegard, R.; Skotheim, T.A. (Div. of Materials Science, Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The potential use of solid polymer electrolytes in electrochemical devices had led to an interest in the electronically conducting polymerionically conducting polymer interface. The polypyrrole-polymer electrolyte interface has been investigated for use in solid state photoelectrochemical cells. A solid state battery with a polyacetylene-polymer electrolyte interface has also been studied. In these studies the performance of the devices was limited by the poor interpenetration of two polymers. In the case of the solid state photoelectrochemical cell, the rate of charge transfer between the semiconductor electrode and the polymer electrolyte was affected. For the solid state battery the rate of ion transport across the interface during doping and undoping of the polymer electrode was affected. In their study the authors investigate the interface between polypyrrole and the polymer electrolyte, poly(ethylene oxide) . LiCf/sub 3/SO/sub 3/ (PEO . LiCf/sub 3/SO/sub 3/). Composites of the two materials were formed by in situ electropolymerization of polypyrrole from pyrrole vapor similar to methods previously reported. The electropolymerization was performed by a potentiostatic pulse technique. The method of pulsed currents is used in the electrodeposition of metals to improve the physical properties of the deposits. The application of this technique to the electrodeposition of synthetic metals has been limited. Here the authors report

on the use of the potentiostatic pulse technique as a means to control the morphology of the polypyrrole and, thus, the morphology of the polypyrrole-PEO . LiCF/sub 3/SO/sub 3/ interface.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 14514, 14589

14553 (CSTB-R—71-87-L) Photovoltaic systems in a built environment. Application to isolated areas and to developing countries. Chevalier, J.L.; Filloux, A. (Centre Scientifique et Technique du Batiment, 75 - Paris (France)). 1987. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756635/JAW.

This report contains informations and proposals for photovoltaic applications in dwellings. It emphasizes sizing and installation considerations and the development and ability to use of the products are examined, with consideration to the user's behaviour. Several sizing methods are reviewed.

14554 New developments in high efficiency silicon concentrator cells. Swanson, R.M. (Stanford Univ., CA (USA)). pp 156-163 of Eighth E.C. photovoltaic solar energy conference. Volume 1. Solomon, I.; Equer, B.; Helm, P. (eds.). Dordrecht, Netherlands; Kluwer Academic Publishers (1988). (CONF-880513—).

From 8. European photovoltaic solar energy conference; Florence, Italy (9 May 1988).

During the last several years there has been a considerable increase in the efficiency of silicon concentrator cells. Several factors have contributed to this development. New cell configurations circumvent some of the shortcomings of previous cell designs. Understanding of carrier transport and recombination in highly doped regions and dense electron-hole plasmas has improved. New computer modeling codes incorporating this understanding have enabled an accurate and predictive design process. Finally, processing techniques have improved to the point where devices are essentially free of defect related losses. This paper reviews these advances. 2 figs., 12 refs.

14555 Central American health clinic project. Ventre, G.G.; Kilfoyle, D. (Univ. of Central Florida, Orlando, FL (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Since early 1986, the Florida Solar Energy Center (FSEC) has been involved in efforts to get large numbers of photovoltaic-powered vaccine refrigeration systems in Central America. These efforts are complementary to and supportive of the World Health Organization's goals to immunize all the world's children from serious infectious diseases by 1990, and to provide "health for all" by the year 2000. To meet these goals, refrigeration for vaccine storage must be extended to many rural areas of the world. Photovoltaics offers an excellent alternative for extending the vaccine cold chain to these remote areas. The Central American Health Clinic Project represents a joint effort between the U.S. Department of Energy (DOE) and the Organization of American States (OAS), with the Pan American Health Organization (PAHO) providing valuable guidance. This paper describes the project in detail, including development of technical specifications for photovoltaic-powered vaccine refrigeration systems; establishment of requirements for training programs for system users; technical descriptions of the six pilot systems that were installed in El Salvador, Guatemala and Honduras; and a proposed large-scale follow-on program.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 14509, 14594, 14595, 14600

14556 (CSTB-TTA-DPE—87-503) Experimental tests, national and international activities for standardization of solar thermal equipments. Filloux, A.; Chevalier, J.L. (Centre Scientifique et Technique du Batiment, 75 - Paris (France)). Jul 1987. 112p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756630/JAW.

This document reports the work done by CSTB in 1986 in the field of the standardization and qualification of solar heating equipments: - 3 technical reports on SDWH, - standardization of a test method to evaluate the thermal performances of SDWH (draft P 50-520), - participation to the work of ISO/TC 180 subcomittees. Three subcommittees and two working groups met in conjunction with the TC meeting in PHOENIX (Arizona), and TC 180 received reports from the subcommittees indicating in each case that a number of working documents would be registered as draft proposals and circulated for voting. The work of subcommittee 3 components other than solar collectors will be a part of the future subcommittee 5 work. Subcommittee 3 is disbanded.

14557 (SAND—87-2290) A final report on the Phase I testing of a molten-salt cavity receiver: Volume 1, A summary report. Smith, D.C.; Chavez, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007062/JAW.

This report describes the successful design, construction, and testing of a solar central receiver using molten nitrate salt as a heat exchange fluid. The receiver is a 4.5-MWt salt-in-tube cavity receiver built as part of the Molten Salt Subsystem/Component Test Experiment. Design studies for large commercial plants (30--100 MWe) have shown molten salt to be an excellent fluid for solar thermal plants as it is a good medium for efficient thermal storage. The properties that make molten salt a good medium for storage, however, make receiver design challenging. This test program was recommended by the utility and industrial participants to address uncertainties in commercial receiver designs. The receiver was designed to incorporate features of commercial receiver designs. The test program was managed by Sandia National Laboratories for the US Department of Energy. The receiver was fabricated off-site and then installed at Sandia National Laboratories' Central Receiver Test Facility in Albuquerque, New Mexico. Solar testing was conducted during a six-month period. The purpose of the testing was to characterize the operational capabilities of the receiver under solar and stand-by conditions. This testing consisted of initial check-out of the systems, followed by steady-state performance, transient receiver operation in clouds, receiver thermal loss testing, receiver start-up operation, and overnight thermal conditioning tests. This report describes the design, fabrication, and results of testing of the receiver. 14 refs., 23 figs., 1 tab.

14558 (SAND—87-2502) A method for designing a redirector/reconcentrator for use at the Central Receiver Test Facility [CRTF]. Ghanbari, C.M.; Mulholland, G.P.; Otts, J.V. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 92p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007297/JAW.

The Central Receiver Test Facility (CRTF), operated for the Department of Energy by Sandia National Laboratories in Albuquerque, New Mexico, was constructed to evaluate design concepts for solar central receivers. The facility consists of an array of 222 heliostats in a northfield configuration that reflects and focuses the sun's energy toward a tower 60 m high. Throughout the history of the CRTF, there has been an interest in beam redirectors or reconcentrators. The objective of this paper is to discuss the numerous code modifications required for the facility code HELIOS to be able to model the redirector-radome configuration. This model simulates the solar flux-density pattern from reflecting concentrators and follows the incident solar radiation through the atmosphere, the collection system, and finally onto the target. The model includes most pertinent factors that influence the optical perform-

ance of a collector system. Although the standard output contains information concerning sun shape distributions and atmospheric attenuation, probably the most useful output is the flux-density pattern at a grid of points on a receiver surface and the integral of this distribution over the surface to obtain power. 3 refs., 17 figs.

14559 **(SAND—88-7038) Commercial direct absorption receiver design studies.** Wu, S.F.; Narayanan, T.V. (Foster Wheeler Solar Development Corp., Livingston, NJ (USA)). Dec 1988. Contract AC04-76DP00789. 93p. NTIS, PC A05 - OSTI. Order Number DE89007290/JAW.

As part of a joint Sandia/SERI study, we designed a commercial-sized molten salt direct absorption receiver for a solar central receiver plant. Thermal and structural analyses of several possible configurations showed the most severe conditions for the absorber arise from operational thermal stresses. For this reason, we selected a thin, cylindrical, pretensioned shell to eliminate potentially damaging compressive stresses. The shell is also compressively loaded from inside through a rigid subpanel and a layer of dense fiber insulation to provide vibration dampening and horizontal pretensioning of the shell. This receiver will be 40% lighter and 30% less expensive than a salt-in-tube receiver of comparable size, and its annual performance benefits are substantial. The newly designed direct absorption receiver has the potential to reduce levelized energy costs from solar central receiver plants by about 15%. 23 refs., 34 figs., 14 tabs.

14560 **Helios modelling of point-focusing solar concentrators.** Strachan, J.W.; Mulholland, G.P. (Sandia National Labs., Albuquerque, NM (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The modifications to the optical code HELIOS which are required in order to model point-focusing concentrators is presented. HELIOS simulates the optical behavior of reflecting heliostats and was written to model central receiver facilities, specifically that of the Solar Thermal Test Facility at Sandia National Laboratories in Albuquerque, New Mexico. This paper discusses the necessary changes to the HELIOS code and to its input files such that it can successfully model point-focusing concentrators while retaining its computational power. A point-focusing concentrator located at the Solar Thermal Test Facility is presented as a sample case.

14561 **Solar central receiver configuration selection.** Stoddard, L.E.; Harder, J.E.; Grosskreutz, J.C.; Hubbell, R.D. (Black and Veatch, Engineers-Architects, Overland Park, KS (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

In a joint effort by the Arizona Public Service Company Team and the Alternative Utility Team of the Utility Solar Central Receiver Studies, two solar central receiver system configurations were evaluated to determine the preferred system configuration for a commercial utility-scale plant. One configuration consisted of a surround heliostat field with an external molten salt receiver, and the other consisted of a north heliostat field with a cavity molten salt receiver. As a result of this study, the surround field external receiver configuration was selected for the conceptual plant design. A key factor in this decision was the receiver tube length constraint, which limits single cavity receiver modules to about 343 MWt. The larger size achievable with external receivers appear to be more cost-effective for commercial-scale solar central receiver plants.

14562 **Performance and cost implications of the fixed-mirror distributed-focus (FMDF) collector.** Dirks, J.A.; Williams, T.A.; Brown, D.R. (Pacific Northwest Lab., Richland, WA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The Fixed Mirror Distributed Focus (FMDF) hemispherical bowl is a solar thermal power technology which has been studied for several years as a potentially attractive means of producing electricity. This paper discusses projections of the collector (concentrator and receiver) performance and cost that could be achieved by five variations of the FMDF technology, based on the assumption of continued technology development and high volume production. The major loss mechanisms were determined for the concentrators and receivers and then design point losses and efficiencies were developed. The Pacific Northwest Laboratory (PNL) computer code SOLSTEP was then used to determine the annual performance. The cost analysis was based on a "commercial" solar thermal industry that could exist by the late 1990s. The industry is assumed to be installing several hundred megawatts per year of electric capacity, and is assumed to have improved the maturity of solar thermal components so that technical and economic risks are similar to other energy systems.

14563 **Design of a solar/oil hybrid plant for the small community solar experiment (SCSE no. 2) at Molokai, Hawaii.** Rogers, W.E.; Borton, D.N.; Bilodeau, E.A.; Inall, E.K. (Power Kinetics, Inc., Troy, NY (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Power Kinetics, Inc. (PKI), under a contract with the U.S. Department of Energy, is building a hybrid solar power station to be installed on the island of Molokai, Hawaii. The station will consist of five modules and produce 250 kW/sub e/ total. Each module consists of a 300 m/sup 2/ point focus collector with polar axis tracking, a ground mounted steam engine driving an induction generator via a cam clutch, an oil fired boiler with economizer and superheater, and a water cooled condenser. The system can produce 363 kg of steam per hour at 6.9 MPa. The steam temperature at the solar receiver exit is 280°C and at the outlet of the superheater, 450°C. The oil fired boiler can produce steam when there is no sun but is used primarily to superheat solar produced steam and supplement the sun when its intensity is low. This hybrid operation is the discussion of this paper.

14564 **Performance assessment of the Vanguard dish-Stirling module in comparison with the Intersol photovoltaic concentrator.** Norris, B.L. (Pacific Gas and Electric Co., Dept. of Engineering Research, San Ramon, CA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The success of the solar parabolic dish-Stirling engine concept for power generation depends to a large extent upon its economic merit in relation to other technologies exhibiting similar patterns of generation. Economic analysis of alternative technologies, in turn, relies upon the expected performance of the technologies. Treating concentration photovoltaic (PV) systems as a benchmark technology, a simple performance assessment is possible using solar data from 1985 at Carrisa Plains, Claifornia, performance data from the 25 kW Vanguard I dish-Stirling module, and performance data from an Intersol concentrating PV module under test at Pacific Gas and Electric Company (PG and E). The side-by-side comparison led to capacity factor estimates of .188 and .264 for the Vanguard module and the Intersol concentrator, respectively. The same analysis, however, led to annual efficiency estimates of .200 and .107, respectively, in apparent contradiction with the capacity factors. The discrepancy in performance estimates may be explained by the daily output patterns of each technology.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 14165, 14582, 14961, 14963, 14984, 15548

14565 **(EMPR/ER—8107) Solar domestic hot water demonstration program. Progress report.** (British Columbia Ministry of Energy, Mines and Petroleum Resources, Victoria (Canada). Energy Resources Div.). 1981. 129p. (CE—02336). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes progress achieved in a demonstration program in British Columbia involving the installation of solar domestic hot water heating systems in 94 homes. The objectives of the program were to examine the performance of such systems, to determine the willingness of the public to use solar energy systems, to determine the technical and marketing status of the solar industry, and to stimulate a wider distribution of suppliers and installers. Houses were selected in six British Columbia cities and 89 of the systems have been installed. Selected designs are described and illustrated: a drainback type system, a closed-loop antifreeze type system, a draindown type system, and a thermosyphon type system. Installation considerations are summarized and problems which were encountered are outlined. The monitoring systems attached to the water heating systems are also described and illustrated; most of these involved inlet and outlet thermometers, and a flowmeter. An appendix contains manufacturers' data and user manuals. 12 figs.

14566 **(EMR—1980) Energy efficient/renewable energy housing designs.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1980. 44p. (In English and French). (CONF-8706282—; CE—02132). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From 15. annual conference of the New England governors and the eastern Canadian premiers; Halifax, Canada (14 Jun 1987).

A competition was held in 1979 among five eastern Canadian provinces and the New England states to design energy efficient/renewable energy housing. It was intended to supply designs that would stimulate the use of energy efficient practices and renewable energy resources among the public. This report presents the winning designs from this competition, giving the projected energy performance data, floor plans, pictorial and verbal descriptions of how the energy systems operate, and estimated costs. Designs include new and retrofitted houses using, as a renewable energy source, active and passive solar heating, and/or wood stoves. The houses also incorporate such energy conserving features as a high degree of insulation, earth berms, thermal energy storage systems, insulated window shades, and heat pumps. 38 figs.

14567 (EMR/CRE—8012, pp 11-15) **The results of a study examining the potential impacts on the electrical utility in Montreal and Winnipeg of different load management approaches for solar heating.** Rogers, J.T. (Carleton Univ., Ottawa, Ont.). 1980. Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). (CONF-8005266—; CE—02255).

From Potential impacts of the deployment of solar heating on electrical utilities workshop; Ottawa, Canada (12 May 1980).

This study was to establish possible impacts of solar space heating and water heating on the utility's load factor. Analysis included four dwelling types, and took into account passive solar and wild heat (heat generated within a house by people, appliances, etc.) gains. Space and water heating demand was estimated on an hourly basis. It was assumed that the standardized solar system (including storage) supplied approximately 50% of the annual heating demand. Using this system, the heating demand and the availability of the solar energy, the computer program calculated the amount of energy supplied by solar. The impact on the back-up electricity required was examined firstly with the on demand approach. The second approach incorporated load management where the solar system was modified slightly to include an electrical energy storage tank. Three different variants of the load management approach were studied. All of them assumed that back-up electrical energy would be available only over a ten hour period. The first assumed that the heaters were in single stage; the other two were staged heaters. The three load management schemes were on demand, and four stage with 200% override, four stage with 120% override. Three levels of penetration, 5%, 10%, 15%, for the solar systems were assumed. The peak load with the all-electric case was 108% of the reference peak, while the peak with solar electric was 106%. The on demand system was always easier on the peak than the all-electric system. Each of the load management systems had a lower impact on the peak than both the all-electric and on demand systems in the earliest stages of penetration. But, as the penetration increases each of them becomes worse than the on demand case and the all-electric case. 2 figs.

14568 **(NRC—SEP2) Solar systems trial programme. Phase 2. Solar heating systems in small multi-unit residential buildings. Report 1, programme initiation and systems installation.** Colley, M.D.; Yen, G. (National Research Council of Canada, Ottawa, Ontario). 1979. 36p. (CE—02248). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A solar systems trials program was conducted in Canada in order to identify problems with the design, installation, operation, and maintenance of such systems; to obtain performance and cost-effectiveness data on solar heating systems applied to small multi-unit residential buildings; and to provide visible demonstration of such systems to the public and the building industry. This report outlines the contract procedures used in the program and the selection procedure used for demonstration systems. Eleven projects were selected for the trials; basic design schematics and system specifications are included. These projects all involve domestic space heating and/or water heating, and some systems are heat-pump-assisted. 14 figs., 2 tabs.

14569 **(NRC/BR—104) Solar heating systems for Canadian buildings. Building research note no.104.** Sasaki, J.R. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). 1977. 22p. (CE—02246). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report reviews current solar heating systems, analyzes the cost competitiveness of solar heating in Canada in comparison with conventional heating methods, and presents some criteria for designing a solar system for Canadian conditions. These criteria cover design of the house for maximum thermal efficiency, selecting the type of system, collector efficiency and orientation, collector durability, heat storage, the type of space-heating circuit, and inclusion of a water heating system. It is shown that the cost differential between solar and conventional heating is not excessively large and should decrease with time. Moreover, because of the large fuel savings from using solar heating, continuing development of solar heating systems for Canadian conditions merits support. 11 refs., 16 figs.

14570 **(NRC/BR—104) Solar heating system for Canadian buildngs. Building research note no. 104.** Sasaki, J.R. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). 1975. 23p. (CE—02247). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report reviews current solar heating systems, analyzes the cost competitiveness of solar heating in Canada in comparison with conventional heating methods, and presents some criteria for designing a solar system for Canadian conditions. These criteria include house design for maximum thermal efficiency, selecting the kind of system, collector efficiency and orientation, collector durability, heat storage, type of space-heating circuit, and inclusion of a water heating system. It is concluded that although solar heating does not at present appear to be economically competitive with conventional methods for any Canadian buildings, the cost differential is not excessively large and may decrease with time. Moreover, because of the large fuel savings over time, continuing development

of solar heating systems for Canadian conditions merits support. 6 refs., 16 figs.

14571 **(WU/RI—1988) Watsun 5.0 interactive solar heating simulation and economic evaluation program. User's manual and program documentation.** (Waterloo Univ., Ontario (Canada). Research Inst.). [1988]. 298p. (CE—02316). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The series of generalized computer programs called WATSUN 5.0 has been developed as a design aid for the study of the technical and economic feasibility of solar-assisted service hot water and space heating systems. The dynamic interactions of system components, such as the collector, the energy storage, the heat pump (if included), are modelled within the framework of their control mechanisms and operating strategies. Simulations based on hourly meteorological data may be carried out for different locations and building types, with several system parameter variables, such as collector area and storage volume. The output includes the monthly and yearly energy consumption and also, if desired, a life-style economic analysis which compares the cost effectiveness of the solar heating system with a conventional reference heating system. The interactive WATSUN 5.0 program has been developed to upgrade model treatment of the solar heating systems, upgrade interactive integrity, extend the modes of program access, and implement expeditious program and manual modification reporting procedures. The net effect of achieving these objectives is to enhanced program model representation of actual systems and to reduce the amount of user time required in order to execute the program. This manual describes the preparation of the input data and includes sample inputs and outputs along with typical Canadian parameter values. The manual discusses the overall operation of the solar heating system, along with a description of the space heating, domestic hot water and reference system models. 21 refs., 43, figs., 6 tabs.

14572 **(WU/RI—7604) WATSUN: solar heating simulation and economic evaluation program. User's manual.** (Waterloo Univ., Ontario (Canada). Research Inst.). 1976. 86p. (CE—02322). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

WATSUN is a computer program, written in Fortran IV, designed to test the economic and technical feasibility of solar space heating systems. The program is capable of simulating three types of systems: liquid-base with short-term storage; air-base with short term storage; and liquid-base with long-term seasonal storage. WATSUN is modular in nature, each module consisting of a system model rather than a component model (except for an optional flat plate collector model). Contained within WATSUN are subroutines which evaluate the life-cycle cost of the system; it can also evaluate the cost of a conventional system, for comparison. The program evaulates a range of system sizes and displays the results, allowing the designer to select the system most suitable to meet individual requirements. The underlying assumption contained within WATSUN is that over a given hour, the ambient temperature, parameters are constant; this dramatically reduces computation costs. Furthermore, quantities which are independent of the system size are calculated initially and then stored for use each time the collector area or storage volume is changed and the system re-evaluated. This document serves as a user manual and presents information on the system models, inputting of data, printed data output, and a program listing. 9 refs., 6 figs., 5 tabs.

14573 **Evaluating and extending f-chart capabilities.** Kummer, J.P.; Braun, J.E.; Beckman, W.A.; Duffie, J.A.; Klein, S.A. (Solar Energy Lab., Univ. of Wisconsin, Madison, WI (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The f-chart and phi bar,f-chart design methods were used to predict the performance of 17 systems from the Solar in Federal Buildings program and the predictions were compared to the measured performance. In the process, it was observed that many system configurations are not fully compatible with the design methods. These non-standard configurations are summarized, and methods are suggested for extending the design methods to account for some of these differences. TRNSYS simulations were used in some cases to study the effect of the configurations on system performance.

14574 **On determining the optimal combination of multiple passive systems, central and zone heating systems and energy conservation measures.** Winn, C.B.; Burns, P.; Guire, J.; Taktak, R. (Dept. of Mechanical Engineering, Colorado State Univ., Fort Collins, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

A simple method for determining the optimal combination of passive solar heating, central heating, and energy conservation features is presented in this paper. The material presented in the Passive Solar Design Handbook was used to synthesize complex economic, weather, and performance data into a design monograph. Using the nomograph and economic variables particular to the building in question, one can easily determine the optimum glazing area, the optimal insulation levels for the thermal envelope for the building, and the optimal heating plant size in order to minimize life cycle costs. An optimal design may be performed in about 15 minutes using the appropriate nomograph and a hand-held, four-function calculator. Alternatively, using an IBM personal computer having one megabyte of memory, an enhanced graphics card or a Hercules card, an enhanced graphics monitor, the Graphics Development Toolkit, and the developed software, the designer can choose a combination of two passive system types, generate the design nomograph, and quickly determine the above-mentioned optimal combination. This simplified design approach incorporates much of the material in the 742-page Passive Solar Design Handbook and enables a designer to easily and accurately determine optimal combinations of passive solar, energy conservation and auxiliary energy so that total system comparisons may be made.

14575 **Analysis and comparison of active solar desiccant and absorption cooling systems.** Warren, M.L.; Wahlig, M.A. (Building Energy Systems Program, Applied Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

As part of the Active Solar Cooling Program LBL has undertaken a comparative analysis of the technical performance of future ventilation mode desiccant systems with proposed advanced absorption and with conventional vapor compression systems. A common framework has been developed for direct comparison of very different cooling technologies. Psychrometric analysis is used to determine the performance of the supply air cooling system. Energy for distribution of air is explicitly determined from component and duct pressure drops assuming a 50% fan efficiency. The parasitic energy requirements of other air side components are also calculated. The size of each component is defined by the design air volume, design face velocity, and pressure drop requirements. For those systems with cooling coils, the chiller is modeled to meet the cooling coil load. Heat rejection is provided by a wet cooling tower which is sized based on the heat rejection requirement of each chiller. In this paper, the modeling of ventilation mode open cycle desiccant and advanced absorption cooling systems are discussed, the methodology for evaluating annual impact of alternative approaches to air conditioning in commercial buildings are described, and results of annual performance analysis in 5 cities are presented.

14576 **Advanced systems design concepts for water and space heating.** Chen, B.; Farrington, R. (Solar Energy Research Institute, Golden, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The purpose of this study was to identify those ideas and concepts which may enhance the acceptability of solar space and domestic hot water heating by the public. Although the study utilized ideas developed in earlier SERI efforts, it was primarily driven by the solar industry itself. Through meetings, workshops, and a questionnaire, a number of ideas and concepts were identified and then subjected to peer review by members of the solar industry. The results of this peer review point to a number of promising ideas and concepts which if given the opportunity to bear fruit could play a significant role in revitalizing a shrunken and demoralized solar industry.

14577 **The effects of geometry changes in a parallel plate rotating silica gel dehumidifier on cooling system performance.** Waugaman, D.G. (Penn State Univ., Wilkes-Barre Campus, Lehman, PA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Desiccant cooling cycles for space conditioning that incorporate a dehumidifier, a heat exchanger and evaporative coolers are viable alternatives to conventional vapor compression air conditioning, especially in climates and applications with significant latent loads. This paper describes the effects of solid rotary desiccant dehumidifier design parameters, such as air passage size, particle size, inert substrate film thickness, wheel depth, air flow rate, regeneration temperature, and wheel rotational speed, on cooling system performance. A heat and mass transfer analogy method of modeling the rotary regenerative dehumidifier has been used which incorporates properties of different materials such as silica gel and inert substrates in a parallel plate geometry.

14578 **Review of measured passive solar performance in the U.S.** Swisher, J.N.; Frey, D.J.; Holtz, M.J. (Architectural Energy Corp., Boulder, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Passive solar buildings have become commonplace in the United States during the last ten years, as designers have attempted to improve the energy efficiency of new buildings. From 1979 to 1985, the U.S. Department of Energy supported research to evaluate the performance of a variety of passive solar designs. Over one hundred buildings have been monitored in detail, and many others have been evaluated using energy billing data and energy audit information. This paper reviews the results of that work.

14579 **Thermal dynamics from component and building tests.** Jeon, H.S.; Subbarao, K.; Burch, J.; Claridge, D.E. (Korea Institute of Energy and Resources, DaeJeon, Korea (KR));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Thermal parameters describing a building must be calculable from component data (as necessary for design studies) or measurable from building tests (as necessary for monitoring projects). To demonstrate that these two approaches are equivalent, a test cell was constructed from components that had been characterized in a hot box to reduce errors in calculation of the whole-building admittances from the component values. On the other hand, measured whole-building admittances were obtained from short-term tests (both indoors and outdoors). Measured and calculated test cell admittances are shown to be in good agreement, with magnitudes agreeing to about 5% on average.

14580 **Development of a short-term field monitoring methodology for active solar domestic hot water systems.** Bingham, C.E.; Farrington, R.B. (Solar Energy Research Institute, Golden, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The objective of short-term field monitoring is to provide a method of nonintrusively determining long-term performance of installed SDHW systems with nonstratified storage tanks in a short time at a low cost. This method can be used as a diagnostic tool to assist in troubleshooting SDHW systems. In this paper the authors discuss the theory behind the proposed methodology and use TRNSYS to develop storage temperature data for a SDHW system to see how the theory works under constant ambient conditions. The effects of initial storage temperature and solar radiation incident on the collector are investigated. The initial analysis shows that under these ideal conditions, the measurement of the rates of charge and discharge of a mixed tank give sufficient data to estimate the lumped system parameters within 10%. Additional work is necessary to remove the ideal conditions imposed in the analysis and able to test this methodology in the field.

14581 **Results from testing and modeling residential load-side heat exchangers.** Farrington, R.B.; Bingham, C.E. (Solar Energy Research Institute, Golden, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The measurement and modeling of immersed coil heat exchangers used in residential solar domestic hot water systems is discussed. Two smooth-coil and two finned-coil heat exchangers, with heat transfer areas of 1.7 and 2.5m/sup 2/, were tested. The measured U-values ranged from 100 W/m/sup 2/ at low temperature differences to as high as 1200 W/m/sup 2/ at high temperature differences. Corresponding Nusselt numbers ranged from 1 to about 35 for Rayleigh numbers of 6.3 x 10/sup 4/ to 7.9 x 10/sup 6/. The 1.7 m/sup 2/ smooth coil had higher heat transfer coefficients than the larger 2.5 m/sup 2/ finned coil. The analytical model developed agreed reasonably well with the experimental results.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 14554, 14558, 14560, 14561, 14562, 14564

14582 **(AMR—7812) An assessment of problems experienced with operating solar systems in Canada and the northern United States.** Lorriman, D. (Moriyama (Raymond) and Associates, Architects and Planners, Toronto, Ontario (Canada)). 1978. 73p. (In French). (CE—02211). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

As part of a study examining the performance of materials and components used in solar heating systems, this report addresses the actual experience with operational systems. It intends to identify factors which tend to shorten the service life of solar components, and deals with the potential problems of various components and actual problems encountered in Canada and the USA. The first part of this report considers flat plate collectors, the dominant type of solar collector in use. Specific problems are discussed in the areas of condensation, dust and dirt; breakage, cracking, chemical degradation, and loss of transmissivity of cover plates; leakage and structural failure of glazings; corrosion, erosion, impact damage, joint/bond failure, and other problems with absorber plates; degradation, discoloration, and application deficiencies of absorber coatings; and outgassing, degradation, and instability of insulation material. The second part deals with general problems of solar systems:

freezing, boiling, corrosion, and inflammability of heat transfer fluids; heat transfer fluid transport, connections, storage, and control; installation-related problems such as excess snow collection, ice dam formation, leakage, and movement of components; maintenance and repair; and other considerations including safety, standards, and aesthetics. An appendix gives a brief discussion of some problems encountered with evacuated tube collectors found at two sites. 87 refs., 75 figs., 10 tabs.

14583 **(NRC—SEL-1) Research on selective materials for solar absorption. Final report.** Hummel, R.L.; Smith, J.W.; Chu, C.Y. (National Research Council of Canada, Ottawa, Ontario). 1977. 48p. (CE—02191). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A research project was conducted on solar absorptive materials to select and test those materials available which, ideally, would be absorptive for wavelengths up to 2-3 micrometers and reflective for longer wavelengths. Organic black dyes were found to have an unsatisfactory spectral range of absorption, and were thermally unstable above 300/sup 0/C. Two asphalts were tested, which were separated into heavy oils and asphaltenes. The heavy oils were not chemically suitable for selective absorbers, but it was felt that the asphaltenes, or substances contained in them, could have potential as effective materials for making selective coatings. Chemical modification of refined asphaltene extracts was explored as a promising route of investigation. Oxidation with peroxide, dichromate, permanganate, and nitric acid did not improve the overall performance; bromination, and sulfur and oxygen treatments, gave products more black than the original asphaltene and offer possibilities for further research. The thermal degradation products of polymers, methyl methacrylate, acrylonitrile, vinyl chloride, and others include black components which may be expected to have some of the desired spectral characteristics. Some preliminary experiments, particularly with halopolymers, suggested this possibility is also worthy of further study. Some extractable compounds from carbon black may also have the desired characteristics, and screening of extract fractions was begun. 42 refs., 39 figs., 3 tabs.

14584 **(ORF/MS—Corr-2) The development of methods of reducing corrosion in solar collectors.** (Ontario Research Foundation, Mississauga (Canada). Dept. of Materials Section). 1977. 80p. (CE—02266). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Corrosion can be minimized in solar collectors by paying proper attention to heat transfer fluids, materials used, and design. The most common heat transfer fluids used in solar systems employ water plus certain additives, and use of these fluids requires special precautions to reduce corrosion to a minimum. These precautions include the use of distilled or deionized water, corrosion inhibitors, and the avoidance of crevices, high and low flow areas, and turbulence. Regular maintenance of the fluid is also required, with periodic testing to determine fluid quality. Proper selection and combination of materials is also necessary to ensure a long service life for a solar system. Precautions must be taken to combine diverse materials in such a way that situations which tend to promote corrosion are avoided. Dielectric materials should be used to join dissimilar metals in order to avoid galvanic corrosion, filters installed to remove scale or metal particles that might initiate pitting corrosion, and gettering columns used to remove metal ions from solution. Sealants, gaskets, and coatings must be chosen to withstand the high collector temperatures, and must be applied so as to seal out contaminants. A number of effective coatings and sealants are suggested. Design of the collector and circulation system should be optimized to prevent corrosion; for example, on external parts, flanges should be narrow and slope downward to permit drainage; and moisture should be excluded from the collector box interior by such means as breather tubes. It is felt that by following this report's recommendations, the service life of solar collectors can be extended considerably. 23 refs., 13 figs., 18 tabs.

14585 **(SES—7806) Development of a fixed position and fixed configuration solar collector.** Michell, J.H. (Solco Energy Systems Ltd., Toronto, Ontario (Canada)). 1978. 52p. (CE—02267). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The design criteria for a liquid-cooled flat plate solar collector were studied, and materials of construction were selected which would be both economic and functional under operating conditions in Canada. Collectors containing copper, aluminum, carbon steel and stainless steel absorber plates were fabricated and tested. It was shown that fabrication of an effective copper absorber plate was simple and offered the small manufacturer the best route to a corrosion resistant solar collector. Aluminum extrusions were chosen for the casing, tempered float glass for the cover and high temperature resistant glass fiber for the insulation. Black chrome was selected as the preferred solar energy absorbing surface. A brief study of blue iron oxide as a selective surface for steel absorber plates demonstrated that this surface was unsuitable owing to its instability under moist conditions. The use of a desiccant-filled breather tube was found to be impractical, simple breather holes in the casing being preferred. Review of a process for reducing the reflectance of a glass covers indicated that the process could not easily be carried out by a small manufacturer. 13 refs., 13 figs., 2 tabs.

14586 **(SV-UL—1987-24) Characterization of transparent insulation.** Pentelius, A.; Torberger, M. (Royal Inst. of Techn., Stockholm (SE). Dept. of Heating and Ventilation). (Swedish State Power Board, Aelvkarleby). 18 Jun 1987. 43p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756306/JAW.

A device for measurement of transmission of solar radiation through materials has been constructed. The solar radiation transmission and R-factors for plane and folded films of teflon and mylar was measured. The insulating effect of these films in solar collectors, between the absorber and the glass, was measured. (L.E.).

14587 **Theoretical and experimental investigation of an active three-branch Ti:$LiNbO_3$ optical waveguide switch.** Belanger, M.; Yip, G.L. (National Institute of Optics, Quebec City, Canada). *Applied Optics;* **28**: No. 1, 53-59(1 Jan 1989).

A theoretical and experimental investigation of an active three-branch multimoded Ti:$LiNbO_3$ waveguide switch is presented. The theoretical study covers the efficiency of the electrooptic index change in a multimoded waveguide, the mode conversion occurring in a tapered transition and, finally, the power division among the branches of the switch. For the experimental characterization, the optical measurements of a device fabricated in a Z-cut $LiNbO_3$ crystal are presented and discussed. Several improvements as well as applications are pointed out.

14588 **Dielectric compound parabolic concentrating solar collector with a frustrated total internal reflection absorber.** Hull, J.R. (Argonne National Laboratory, Argonne, Illinois 60439). *Applied Optics;* **28**: No. 1, 157-162(1 Jan 1989).

Coupling a dielectric compound parabolic concentrator (DCPC) to an absorber across a vacuum gap by means of frustrated total internal reflection (FTIR) can theoretically approach the maximum concentration permitted by physical laws, thus allowing higher radiative fluxes in thermal applications. The calculated optical performance of 2-D DCPCs with FTIR absorbers indicates that the ratio of gap thickness to optical wavelength must be {0.22 before the optical performance of the DCPC is superior to that of the nondielectric CPC.

14589 **Recent advances in photovoltaic concentrator technology.** Maish, A.B.; Boes, E.C. (Sandia National Labs., Albuquerque, NM (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Photovoltaic concentrator technology is experiencing rapid, significant advances in efficiency, cost and reliability which make it a leading candidate to add to the nation's electrical generating ca-

pacity in the next decade. This paper reviews the development path being pursued by the Department of Energy program to achieve its near-term energy cost goals and to transfer this technology to the private sector. The paper summarizes the research status of concentrator cells, components, modules and arrays. System reliability is also discussed in the context of a new reliability program.

14590 **Cavity receiver heat loss measurements.** Stine, W.B.; McDonald, C.G. (California State Polytechnic Univ., Pomona, CA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Measurements of heat loss from a cavity receiver at different attitudes and temperatures are presented. The receiver tested is from the 23-ft (7 m) diameter parabolic dish concentrating solar collectors at the Solar Total Energy Project at Shenandoah, Georgia. The receiver cavity is a wound-tube type which is cylindrical with a conical end section. The cavity has a maximum diameter of 26 in. (0.66 m) and length of 27 in. (0.69 m) and an 18-in. (0.46 m) diameter aperture. Total heat loss measurements were made, without incident solar flux, at temperatures from 300° to 600°F at receiver orientations from aperture-down to aperture-up. Conduction loss was isolated using an insulated aperture plug and the radiation loss measured. The remaining heat loss was assumed to be by free convection. Conclusions are drawn as to the effect of cavity orientation and temperature on convective heat loss, and aperture radiation loss from a cavity with a high aperture-to-internal diameter ratio.

14591 **Composite membrane parabolic concentrator research.** Beninga, K.J.; Butler, B.L.; Kutscher, C.J. (Science Applications International Corp., (SAIC), San Diego, CA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Science Applications International Corporation (SAIC) under support from the Solar Energy Research Institute (SERI) has developed a pre-formed composite, parabolic membrane of fiberglass-reinforced polyester for use in dish concentrators. A lay-up technique has been developed to impart near-isotropic mechanical properties to the composite membrane. These membranes are formed on very smooth molds to provide high specularity to the reflector surface. Techniques are forming large diameter molds and membranes at minimal cost are currently under development. The optical characteristics and structural properties of the composite membranes are discussed. The membranes are thin and flexible enough to be rolled up for ease of transportation and they are then unrolled and attached to a ring frame at the site for subsequent differential pressure stabilization. The composite membranes have excellent resistance to creep under tension, as opposed to polymer film membranes.

14592 **A performance comparison of multi-facet and single-facet dishes.** Wendelin, T.J.; Lewandowski, A. (Solar Energy Research Institute, Golden, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Membrane dish concentrators offer a promising alternative to current parabolic dish concepts in that they are potentially lighter in weight and perhaps less costly than their glass/metal counterparts. However, a technical question exists regarding the best approach for the membrane reflector configuration. Although a single-facet design would achieve higher cocentration than a multi-facet design, the multi-facet concept might benefit from easier fabrication as well as take advantage of the available membrane and reflector material widths. A stretched membrane dish can be fabricated either by large deformation of a flat membrane or initially preforming the membrane into a parabolic shape. At focal length to diameter ratios (f/D's) greater than 1.0, the performance difference between the shapes resulting from these fabrication methods is small. Thus, in a multi-facet design, where the f/D's of the individual facets are large, the deformation of an initially flat membrane could be used to easily fabricate relatively small spherical facets. This paper studies the optical and thermal performance of single and multi-facet stretched membrane dish reflectors. A single-facet parabola and 3, 7, and 19 spherical facet configurations were analyzed over a range of focal lengths. Optical efficiency, sensitivity to astigmatism, and overall thermal performance (at 800 C) were investigated to determine the best performance and corresponding aperture size (i.e. concentration ratio) for each case. This was done both with and without a secondary concentrator at or near the entrance aperture of the receiver.

14593 **Heat loss experiments on the Category B solar receiver.** Boehm, R.; Nakhaie, H.; Berg, D. Jr. (Mechanical and Industrial Engineering Dept., Univ. of Utah, Salt Lake City, UT (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Heat loss experiments have been performed on the "Category B" solar receiver that was evaluated during the spring and early summer of 1987 at the Central Receiver Test Facility in Albuquerque, New Mexico. This receiver offers special challenges for analysis in that it consisted of both external (wing panels on each side of the cavity) and cavity aspects. Both flux-off and flux-on evaluations were performed. Experimental uncertainties are estimated. Use of a modification to the Barron flux-on technique reduces uncertainties slightly. Comparisons are made between the experimentally inferred loss quantities and predicted loss quantities. The several assumptions made in the data reduction are noted and evaluated. Problem areas with the current experiments are outlined.

14594 **Thermal modeling of solar central receiver cavities.** Skocypec, R.D.; Romero, V. (Fluid and Thermal Sciences Dept., Sandia National Labs., Albuquerque, NM (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Results are presented from a numerical model of the steady-state energy transfer in molten-salt-in-tube solar cavity receivers that includes convective energy transfer at a local (spatially resolved) level. Molten salt energy absorption and gray radiative transfer between all cavity surfaces are also included. This model is applied to the MSS/CTE cavity receiver. Results for this receiver indicate the global receiver thermal efficiency is invariant within a few percent to most parameters investigated, although front surface temperatures of the nonabsorbing walls vary considerably, and are particularly sensitive to the type of convective submodel used. Absorption efficiencies indicate the effects of the cavity enclosure environment. For all conditions investigated, tube inner wall temperatures remain under 855 K, ensuring that the salt remains chemically stable. Global (entire cavity) results for the receiver indicate thermal conditions in the receiver are temporally constant within an hour of solar noon, and solar panel temperatures are governed by the temperature of the flowing salt (the outlet temperature is maintained at 839 K by varying the salt flowrate). The dominant loss mechanism is radiative transfer, although convective loss predictions are of the same order of magnitude.

14595 **Characterization testing of a solar molten salt central receiver.** Smith, D.C.; Chavez, J.M. (The Babcock and Wilcox Co., Barberton, OH (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

A solar central receiver was designed, constructed, and tested in a program funded by the U.S. Department of Energy. The receiver tested is an advanced 5 MWt cavity receiver, that uses molten salt as the working fluid. The receiver was solar tested during a six-month period at the Central Receiver Test Facility in

Albuquerque, NM. The purpose of the testing was to characterize the operational capabilities of the receiver under a number of solar operating and stand-by conditions. This testing consisted of initial check-out of the systems, followed by steady-state performance, transient receiver operation, receiver operation in clouds, receiver thermal loss testing, receiver start-up operation, and overnight thermal conditioning tests. The results of this testing are presented in this paper.

14596 **Direct absorption receiver flow experiments.** Chavez, J.M.; Tyner, C.E.; Couch, W.A. (Solar Energy Dept., Sandia National Labs., Albuquerque, NM (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

In a solar central receiver system Direct Absorption Receiver (DAR), the heat absorbing fluid (a blackened molten nitrate salt) flows in a thin film down a vertical panel (rather than through tubes as in conventional receiver designs) and absorbs the concentrated solar flux directly. To better understand flow phenomena in this type of receiver, the authors are conducting flow tests using water (because its flow properties are similar to molten salt) and planning a 3 MWt solar-heated DAR panel research experiment using salt. In this paper, they discuss the results of the water flow testing, including manifold development, film stability, wave phenomena, and wind and natural convection effects on flow. In addition, they describe the design of the panel research experiment and planned testing.

14597 **Direct absorption receiver control studies.** Tyner, C.E.; Kolb, G.J. (Central Receiver Technology Div., Sandia National Labs., Albuquerque, NM (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

In a solar central receiver system Direct Absorption Receiver (DAR), the heat absorbing fluid (a blackened molten nitrate salt) flows in a thin film down a vertical panel (rather than through tubes as in conventional receiver designs) and absorbs the concentrated solar flux directly. This unique flow system presents different control requirements than other receiver systems. In this paper the authors discuss these requirements, including analyses of multiple control zones for various receiver geometries and steady-state flux patterns. These results show that as few as nine to thirteen control zones can provide adequate operation of the receiver under nearly all conditions. They also discuss the simple outlet-temperature-feedback control algorithm develop to control the DAR during cloud transients and present system thermal/hydraulic responses to various transient conditions.

14598 **Effect of injection parameters on solar pond gradient formation.** Zangrando, F.; Johnstone, H.W. (Solar Energy Research Institute, Thermal Systems Research Branch, Golden, CO (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The simplest method to establish the stratified region in operating solar ponds has been to inject fresh or low salinity brine into an initially unstratified layer of dense fluid and to move the injection diffuser upwards at a rate proportional to the rise of the surface position. In the past, it was assumed that the inject fluid mixed with ambient fluid at the level of the injection diffuser. Laboratory tests have shown that the effective mixing depth of the injected fluid is a strong function of injection Froude number Fr, which typically changes as the filling process proceeds. At a critical Fr around 16-18, the resulting gradient boundaries coincide with the initial and final position of the injection diffuser. At Fr greater (smaller) than the critical value, the resulting position of gradient boundaries can be substantially lower (higher) than the diffuser position. This variation can have a serious impact on the resulting stratification because the thickness and density gradient of the stratified region can differ substantially from the original plan, resulting in potential gradient instabilities. Laboratory results compare well with results obtained at the El Paso, Texas solar pond.

14599 **Experimental investigation of a direct contact heat exchanger with structured packing.** Kowalski, G.J.; Loud, R.L.; Kreith, F. (Northeastern Univ., Boston, MA (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Preliminary results from experiments in which the volumetric heat transfer coefficient is measured for a direct contact heat exchanger with and without structured packing are described. The working fluids are water, the continuous phase and Chevron GST-32 oil, the dispersed phase. The test column is 0.61 m in diameter and has a length of 3 m. The operating temperatures are a water inlet temperature of 60°C and an oil inlet temperature of 35°C. The flow rates of the water are varied from 0.001 to 0.003 cubic meters per second, while the oil flow rates are varied from 0.0009 to 0.0015 cubic meters per second. The holdup as calculated from correlations varies from 0.003 to 0.03 which is approximately twenty percent of the holdup at flooding limit. The expected experimental uncertainty for the volumetric heat transfer coefficient equals +- 20%. The volumetric heat transfer coefficient with the packing installed in the column is twice that measured without the packing. The operating behavior, (droplet size, shape and emulsibility characteristics), of the direct contact heat exchanger with the structured packing is compared to that of a heat exchanger without the packing.

1420 Heat Storage

REFER ALSO TO CITATION(S) 14508, 14580

14600 **Performance evaluation of molten salt thermal storage systems.** Kolb, G.J.; Nikolai, U. (Central Receiver Technology Div., Sandia National Labs., Albuquerque, NM (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Thermal performance tests have been performed on the molten salt thermal storage system located at the Central Receiver Test Facility (CRTF). The 7 MWht system is composed of a hot storage tank containing molten nitrate salt at a temperature of 566 C and a cold tank containing 288 C salt with associated valves and controls. The thermal performance of this system was evaluated and compared with three storage systems developed by the European solar community. Results of the comparison indicate that salt storage systems have higher efficiencies than a system employing an oil and iron storage medium. Test data were also used to validate a simulation model of the CRTF system and a proposed 1200 MWht system. The simulation model of the 1200 MWht system predicted an annual system efficiency of greater than 98%.

15 GEOTHERMAL ENERGY

1502 Geology And Hydrology Of Geothermal Systems

14601 **Thermal regime of the State 2—14 well, Salton Sea Scientific Drilling Project.** Sass, J.H.; Priest, S.S.; Duda, L.E.; Carson, C.C.; Hendricks, J.D.; Robison, L.C. (U.S. Geological Survey, Flagstaff, Arizona). *Journal of Geophysical Research;* **93**: No. B11, 12995-13004(10 Nov 1988).

Temperature logs were made repeatedly during breaks in drilling and both during and after flow tests in the Salton Sea Scientific Drilling Project well (State 2—14). The purpose of these logs was to assist in identifying zones of fluid loss or grain and to characterize reservoir temperatures. At the conclusion of the active

phase of the project, a series of logs was begun in an attempt to establish the equilibrium temperature profile. Initially, we were able to log to depths below 3 km, but beginning in late May of 1986, it was impossible to log below about 1.8 km owing to casing failure. Our best estimates of formation temperature below 1.8 km are 305° +- 5 °C at 1890 m and 355° +- 10 °C at 3170 m. For the upper 1.8 km the latest temperature log (October 24, 1986), using a digital "slickline" (heat-shielded downhole recording) device, was within a few degrees Celsius of equilibrium, as confirmed by a more recent log (July 31, 1987) to a depth of ~1 km.

14602 **Shallow drilling in the Salton Sea region: The thermal anomaly.** Newmark, R.L.; Kasameyer, P.W.; Younker, L.W. (Earth Sciences Department, Lawrence Livermore National Laboratory, University of California, Livermore). *Journal of Geophysical Research;* **93**: No. B11, 13005-13024(10 Nov 1988).

During two shallow thermal drilling programs, thermal measurements were obtained in 56 shallow (76.2 m) and one intermediate (457.3 m) depth holes located both onshore and offshore along the southern margin of the Salton Sea in the Imperial Valley, California. These data complete the surficial coverage of the thermal anomaly, revealing the shape and lateral extent of the hydrothermal system. The thermal data show the region of high thermal gradients to extend only a short distance offshore to the north of the Quaternary volcanic domes which are exposed along the southern shore of the Salton Sea. The central thermal anomaly has an arcuate shape, about 4 km wide and 12 km long. Across the center of the anomaly, the transition zone between locations exhibiting high thermal gradients and those exhibiting regional thermal gradients is quite narrow. Thermal gradients rise from near regional (0.09 °C/m) to extreme (0.83 °C/m) in only 2.4 km. The heat flow in the central part of the anomaly is greater than 600 mW/m^2 and in the two local anomalies exceeds 1200 mW/m^2. The shape of the thermal anomaly is asymmetric with respect to the line of volcanoes previously thought to represent the center of the field, with its center line offset south of the volcanic buttes. There is no broad thermal anomaly associated with the magnetic high that extends offshore to the northeast from the volcanic domes.

14603 **Analysis of P and S wave vertical seismic profile data from the Salton Sea Scientific Drilling Project.** Daley, T.M.; McEvilly, T.V.; Majer, E.L. (Center for Computational Seismology, Lawrence Berkeley Laboratory, University of California, Berkeley). *Journal of Geophysical Research;* **93**: No. B11, 13025-13036(10 Nov 1988).

As part of the Salton Sea Scientific Drilling Project at California State well 2—14, vertical seismic profile (VSP) data were collected from P and S wave sources at two distances from the well. Use of a three-component geophone, along with rotation of the recorded data traces into a wave front-based coordinate system, allows analysis of many aspects of seismic wave propagation properties around the well. Standard VSP analysis techniques were used to measure interval P and S wave velocities and to identify reflecting horizons both within and below the survey interval (from 455 to 1735 m). A reflection from below the survey interval, seen with both P and S sources, seems to be associated with a fractured reservoir near 2100 m. Indications of fracturing were observed, including vertical scattering of P waves from a zone near 915 m. Orthogonally polarized shear waves were generated at each offset to study anisotropy by travel time measurement and particle motion analysis of the shear wave arrivals. Three component particle motion analysis of shear wave arrivals was found to be effective for characterizing the subtleties in the S wave splitting throughout the various zones in the well. The SH/sub t/ source (horizontal and transverse to the well) produced complicated, elliptical particle motion while the SV source (in-line with the well) produced linear particle motion. The difference in linearity of particle motion from orthogonally polarized shear wave sources was unexpected and may be related to regional tectonics. Anomalous zones may be related to transition depths in the Salton Sea geothermal field. Travel time difference between SV and SH waves, while clearly observable, indicates only about 1% average anisotropy.

14604 **Borehole gravity measurements in the Salton Sea Scientific Drilling Project well State 2—14.** Kasameyer, P.W.; Hearst, J.R. (Lawrence Livermore National Laboratory, Livermore, California). *Journal of Geophysical Research;* **93**: No. B11, 13037-13046(10 Nov 1988).

Borehole gravity measurements over a depth range from 1737 to 1027 m and the vertical gradient of gravity above ground were measured at the Salton Sea Scientific Drilling Project well State 2—14. Uncorrected borehole gravimetric densities match values from gamma-gamma logs, indicating that the high densities seen in State 2—14 in the depth range 0.5—3 km extend for a few kilometers from the well. The aboveground gradient was found to be 4.1 μGal/m higher than expected; correcting for this value increases the gravimetric density in the borehole. Combining the borehole gravity and estimated vertical gravity gradients on the surface, we find that this densified zone coincides with much of a broad thermal anomaly that has been found to the northeast of the Salton Sea geothermal field. copyright American Geophysical Union 1988

14605 **Laboratory-determined transport properties of core from the Salton Sea Scientific Drilling Project.** Lin, W.; Daily, W. (Lawrence Livermore National Laboratory, Livermore, California). *Journal of Geophysical Research;* **93**: No. B11, 13047-13056(10 Nov 1988).

Two cores from the Salton Sea Scientific Drilling Project have been studied in the laboratory to determine electrical resistivity, ultrasonic velocity, and brine permeability at pressures and temperatures close to estimated borehole conditions. Both samples were siltstones; the first sample was from 1158-m depth, and the other was from 919-m depth. A synthetic brine with 13.6 weight percent NaCl, 7.5 weight percent $CaCl_2$, and 3.2 weight percent KCl was used as a pore fluid. The dry bulk density of the first sample was 2.44 Mg m^{-3} with an effective porosity of 8.7%. The second sample had a dry bulk density of 2.06 Mg m^{-3} with an effective porosity of 22.2%. At the midplane of the first sample, electrical impedance tomography was used to map the spatial variation of resistivity during the experiment. Also, at the midplane of both samples, ultrasonic tomography was used to map the spatial variation of P wave velocity.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 14610, 14611

14606 **(LA—11379-HDR) Hot dry rock geothermal energy development program: Annual report, Fiscal year 1986.** Dash, Z.V.; Grant, T.; Jones, G.; Murphy, H.D.; Wilson, M.G. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007102/JAW.

Preparation, execution, and analysis of a 30-day Initial Closed-Loop Flow Test (ICFT) of the Phase II reservoir were the primary objectives of the Hot Dry Rock Program in fiscal year 1986. The ICFT successfully tested the Phase II heat-extraction loop with the injection of 37,000 m^3 of cold water and production of 23,000 m^3 of hot water, extracting up to 10 MW/sub t/ when production reached 0.0139 m^3/s at 192{degree}C. By the end of the test, water loss rate has decreased to 26% and a significant portion of the injected water had been recovered, 66% during the test and an additional 20% during subsequent venting. Geochemical, tracer, and seismic analyses suggest reservoir fracture volume was growing throughout the test. A new technique, the "three-point" method, was developed to determine locations and orientations of seismically active planes. Fault or joint planes are identified in what superficially appears to be an amorphous microearthquake location set. Five planes were determined when the three-point method was applied to a location data set for the massive hydraulic-fracturing experiment conducted in 1983. 23 refs., 19 figs., 3 tabs.

14607 **(LBL—25135) Modeling of geothermal reservoirs: Fundamental processes, computer simulation, and field applications.** Pruess, K. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 7p. (CONF-8811150—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006662/JAW.

From 10. New Zealand geothermal workshop; Auckland, New Zealand (2 Nov 1988).

This article attempts to critically evaluate the present state of the art of geothermal reservoir simulation. Methodological aspects of geothermal reservoir modeling are briefly reviewed, with special emphasis on flow in fractured media. Then we examine applications of numerical simulation to studies of reservoir dynamics, well test design and analysis, and modeling of specific fields. Tangible impacts of reservoir simulation technology on geothermal energy development are pointed out. We conclude with considerations on possible future developments in the mathematical modeling of geothermal fields. 45 refs., 4 figs., 2 tabs.

14608 **(PB—89-131387/XAB) Design and construction of the NMSU (New Mexico State University) geothermally heated greenhouse research facility. Technical report (Final), 17 November 1983-31 July 1987.** Schoenmackers, R. (New Mexico Research and Development Inst., Santa Fe (USA)). Nov 1988. 48p. (NMRDI—2-72-4214). NTIS, PC A03/MF A01.

This report describes the design, construction and performance of the New Mexico State University (NMSU) Geothermal Greenhouse Research Facility. Two 6,000-square-foot greenhouses were built on the NMSU campus and supplied with geothermal energy for heating. The geothermal water is pumped from one of three wells producing water at temperatures from 141 to 148 F. Heat is delivered to the greenhouse space by means of overhead fan-coil unit heaters. The two greenhouses are double-glazed on roof and wall surfaces employing a total of four different film materials: Tedlar, Melinex, Softglass, and Agrifilm. One greenhouse is cooled using a traditional fan and pad-cooling system. The second greenhouse is cooled with a high-pressure fog system and natural ventilation through roof and side vents. A 2,400-square-foot metal building next to the greenhouses provides office, work, and storage space for the facility.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 14608

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 14606, 14607

14609 **(DOE/ER/13711—2) Anisotropic yielding of rocks at high temperatures and pressures: Technical progress report No. 2, 16 December 1987--15 December 1988.** Kronenberg, A.K.; Russell, J.E.; Carter, N.L.; Handin, C.J.; Gottschalk, R.R.; Shea, W.T. (Texas A and M Univ., College Station (USA). Center for Tectonophysics). Jan 1989. Contract FG05-87ER13711. 127p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006616/JAW.

Progress has been made towards the quantitative determination of anisotropic yield criteria for several foliated and lineated rocks, towards developing models for their mechanical properties based upon interactions between deformation mechanisms and pre-existing fabric elements, and towards the characterization of fabrics resulting from diapiric emplacement of magma bodies within shallow portion of the earth's crust. The suite of extension and compression experiments on Four-mile gneiss is nearly complete. Samples cored along six different orientations have been tested at temperatures ranging from 25{degree} to 800{degree}C and confining pressures of 0 to 400 MFa at a strain rate of 10/sup {minus}5//s, and we are currently investigating the influence of strain rate on yield strength over the range 10/sup {minus}4/≦{dot←{var←epsilon}}≦10/sup {minus}6//s. We have examined deformation microstructures of deformed gneiss samples and identified those processes at the grain scale which are associated with its inelastic response. The orthorhombic anisotropy of fracture strength exhibited by the gneiss may be explained by a simple model involving localized slip within micas and microcracking within the stronger, surrounding framework silicates. Micas appear to interact in much the same way as do Mode II shear cracks, and their density, distribution, and preferred orientation affect the nucleation of microcracks which ultimately lead to failure. Ten material parameters of a generalized anisotropic yield function for Four-mile gneiss at room temperature have been determined using nonlinear fitting methods applied to the completed room temperature data. 45 refs.

14610 **(LA-UR—89-57) A combined heat transfer and quartz dissolution/deposition model for a hot dry rock geothermal reservoir.** Robinson, B.A.; Pendergrass, J. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 16p. (CONF-890114—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006544/JAW.

From 14. workshop on geothermal reservoir engineering; Stanford, CA, USA (24 Jan 1989).

A kinetic model of silica transport has been coupled to a heat transfer model for a Hot Dry Rock (HDR) geothermal reservoir to examine the effect of silica rock-water interactions on fracture aperture and permeability. The model accounts for both the dissolution and deposition of silica. Zones of local dissolution and deposition were predicted, but their effect on aperture and permeability were fairly small for all cases studied. Initial rock temperature, reservoir size, and the ratio of rock surface area to fluid volume have the largest effect on the magnitude of silica mass transferred between the liquid and solid phases. 13 refs., 6 figs.

14611 **(LBL—23546) A multi-feedzone geothermal wellbore simulator.** Bjornsson, G. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 102p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006708/JAW.

The main objective of this work is to develop a multiple feedzone wellbore model for single- or two-phase flow in vertical wells. It has been demonstrated in various fields (e.g., oil and gas and geothermal) that multiple feedzones with different pressure potentials can significantly effect the well performance in the long run. Very little work in this subject has been done to date, but the importance of the subject is becoming more and more evident. 55 refs., 33 figs., 4 tabs.

16 TIDAL AND WAVE POWER

1608 Wave Energy Converters

14612 **(STEV-NYEL—88-10) Research in Sweden concerning the area of wave power.** Hardell, R. (Energia AB, Karlskrona (SE)). (Statens Energiverk, Stockholm (Sweden)). Oct 1988. 14p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756298/JAW.

Government financed research and development of wave power has been evaluated. The motivation of further contributions are discussed. Future potential and conditions for electric power generation in Swedish coastal waters have been considered. (G.B.).

17 WIND ENERGY

REFER ALSO TO CITATION(S) 14860

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 14623

14613 **(CSTB-EN-CLI—87-2-R) Preliminary study of wind characteristics at Pointe de Torricella.** Flori, J.P. (Centre Scientifique et Technique du Batiment, 75 - Paris (France)). 1987. 17p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756636/JAW.

Permanent measurements of mean wind speed and direction were made at three levels above ground (10-20-30 m) from june 1986 to december 1986 at Pointe de Torricella (Cap Corse) on a site of complex topography. Mean wind speed at 10 m and wind rose for the site and the semaphore of Cap Corse for the measurements period were determined. Some flow characteristics (Wind profile, direction fluctuations, turbulence intensity) are presented. These first results indicate that the wind potential is interesting and that the topography have some pronounced influence on flow parameters.

14614 **(CSTB-EN-CLI—87-13-L) European wind atlas. Estimation of the wind speed perturbation over some mountainous regions.** Sacre, C. (Centre Scientifique et Technique du Batiment, 75 - Paris (France)). 1987. 415p. (In French). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88756637/JAW.

This work is a part of the wind energy program of the EC commission on the wind Atlas for the European Community. It presents estimation by numerical simulation of the wind velocities in eight mountainous regions: Corsica and Massif Central in France, the Sauer-land in German Federal Republic, Andros and Tinos islands in Greece, the North-West coast of Irish Republic, Sardinia in Italy, and Scotland in United Kingdom.

14615 (IA—1440, pp 94-95) **Remote measurement of wind speed and meteorological parameters by lidar system.** Fastig, S.; Kutasov, D.; Schoenberg, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

14616 **Wind energy potential in the United States.** Elliott, D.L. (Pacific Northwest Lab., Richland, WA (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

An updated assessment of the wind energy resource throughout the United States and its territories was recently completed by the Pacific Northwest Laboratory. The results of this assessment are described in a comprehensive document, Wind Energy Resource Atlas of the United States published by the Solar Energy Research Institute. The atlas includes over 100 maps (30 in color) and lists wind resource statistics for over 1000 locations. The distribution of the wind energy resource is depicted both on a national scale and in greater detail for each state or territory. Most of the data used in the earlier assessments were from conventional locations, such as airports and military bases; most of the new site data were from well-exposed locations more representative of potential wind turbine sites. After these new site data were analyzed, the annual and seasonal average wind energy resource estimates, the certainty ratings (degree of confidence credited to the resource estimates), and areal distributions (percent land area having a specified wind resource) were revised over many areas of the United States. This paper describes the results of the updated wind energy assessment and highlights some of the major wind resource areas in the contiguous United States.

1703 Regulations

14617 **(ECN—88-177) Certification of wind turbines in the Netherlands. State of art.** Stam, W.J. (Netherlands Energy Research Foundation, Petten). Jul 1988. 11p. Stichting Energieonderzoek Centrum Nederland, P.O. Box 1, 1755 ZG Petten, Netherlands.

Report presented at the European wind energy conference, Herning, Denmark, 6-10 June 1988.

Since the introduction of the Integral Program Wind Energy (IPW) in the Netherlands in 1986, a quality certificate issued by the Netherlands Energy Research Foundation (ECN) is one of the conditions for wind turbine buyers to obtain the new investment subsidy. Therefore ECN investigates the design and a specimen of a wind turbine type for safety and energy output. A certificate is issued if ECN has established that the design and the specimen examined meet the criteria for certification which were applied by ECN at the data of issue. The certification rules including the criteria and verification methods are briefly summarized. Furthermore, an updated survey is given of the wind turbine types which have been certified. By June 1988 eleven certificates had been issued. At this moment an ECN-certificate is required by licensing authorities, buyers and investors. Also some insurance companies have incorporated the measurement of a certificate in their insurance conditions. Therefore the certificate appeared to be a powerful commercial document for a manufacturer. In practice the certification process has helped to improve the quality of wind turbines installed in the Netherlands. 2 tabs.

1704 Economics

REFER ALSO TO CITATION(S) 14617

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 14616, 14616

14618 **(ECN—88-170) Acoustic noise measurements of a Windvang 160.80 RWT windturbine, manufactured by Berewoud Energie BV, at the wind turbine test station of ECN.** Van der Borg, N.J.; De Vries, P. (Netherlands Energy Research Foundation, Petten). Nov 1988. 18p. (In Dutch). Stichting Energieonderzoek Centrum Nederland, P.O. Box 1, 1755 ZG Petten, Netherlands.

Within the scope of the certification of the Windvang 160.80 RWT wind turbine the acoustic noise production was measured of the turbine at the wind turbine teststation of ECN. The acoustic source power was determined at several values of the wind velocity. The applied measurement method was in close agreement with the ICG report IL-HR-13-01 'Handleiding meten en rekenen industrielawaai'. The immission relevant source power level appeared to be 97.6 dB(A) at a wind velocity at rotor height of 5 to 8 m/s. 3 figs., 6 refs., 1 app.

14619 **(LUTFD2/TFRT—5370-1-104(1987)) Search routine for optimization of the power in a wind power plant with variable speed.** Bengtsson, P. (Foersvarets Forskningsanstalt, Stockholm (SE). Huvudavd. 2). (Lund Univ. (Sweden). Dept. of Automatic Control). Sep 1987. 105p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756274/JAW.

To get a wind power plant with variable speed to deliver maximum power at actual windspeed is it important that the speed of the turbine is correct. This paper describes a method how to obtain this, by optimization of a parameter of amplification, KQ, in the electrical control of the power plant. A model of the wind power plant and the optimizing algorithm have been designed and implemented in the simulation language Simnon. The optimization algorithm works in the following way. Add a testsignal to KQ so that a power variation is obtained. Estimate the crosscovariance between the testsignal and the power variation. The result of the estimation is then used to adjust KQ to its optimum. Simulations with the model shows that it is possible to optimize KQ, even in wind disturbed by turbulence, when starting with wrong KQ value.

14620 **(NAE—LTR-LA-74) Preliminary tests of a high speed vertical axis windmill model.** South, P.; Rangi, R.S. (National Aeronautical Establishment, Ottawa, Ontario (Canada)). 1971. 11p. (CE—02261). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report discusses a fixed-pitch vertical axis windmill that combines the inherent simplicity of this type of machine with a high aerodynamic efficiency and a high relative velocity. A three-bladed rotor was selected as the basic design, having constant chord symmetric airfoil blades configured in a catenary curve such that the rotor diameter is equal to the rotor height. In wind tunnel tests using a 30 inch scale model, it was found that once this rotor was given a very low rotational speed, it picked up speed and ran

at a rotor tip velocity/wind speed ratio greater than 1. The number of blades was varied in the testing. A maximum power coefficient of 0.67 was achieved at 17 ft/s wind speed at a tip speed/wind speed ratio of 7.25 for a 2-bladed rotor. Increasing the number of blades above 3 did not result in higher power. The rotor could operate in gusts which double the mean wind velocity. Examination of Reynolds number effects, and taking into account the scale of the model, it was concluded that a full-scale windmill could run at lower velocity ratios than those predicted by the model tests, and that it could self-start under no-load conditions if the cut-in rpm are at least half the rpm for maximum power at the prevailing wind speed. Preliminary estimates show that a 15 ft diameter windmill of this design, designed to operate with a safety factor of 2.5 up to a maximum wind speed of 60 ft/s, would weigh ca 150 lb and could be marketed for ca $60.00, excluding the driven unit, if sufficient quantities were produced to make tooling costs negligible. Similarly, a 30 ft windmill would weigh ca 1000 lb and cost ca $400.00. 2 refs., 6 figs.

14621 **(NAE—LTR-LA-105) A wind tunnel investigation of a 14 ft diameter vertical axis windmill.** South, P.; Rangi, R.S. (National Aeronautical Establishment, Ottawa, Ontario (Canada)). 1972. 17p. (CE—02259). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A 14-ft diameter Darrieus type windmill, whose design was based on a scale model tested previously, was tested in a wind tunnel in order to confirm the scaled-up test results from the model. The rotor was tested in two- and three-bladed configurations, with spoilers attached to the blade to limit speed. Wind speed used in the test was 18.2 ft/s, and the rotor rpm were varied during the tests. Power output was 0.6 to 0.66 hp at 150 rpm depending on configuration. Maximum aerodynamic efficiency occurred at a tip speed/wind speed ratio of about 6 for the two-blade design. Spoilers had the effect of reducing the power output to 0.2 hp at 150 rpm, indicating that they could be used effectively to limit the maximum speed. The rotor would not self-start even when unloaded; however, little effort was required to accelerate it to the starting speed. Rotor output was not found to be too sensitive to imperfections in the airfoil shape. 1 ref., 7 figs.

14622 **(NAE—LTR-LA-183) The design of high-speed windmills suitable for driving electric generators.** Klein, G.J. (National Aeronautical Establishment, Ottawa, Ontario (Canada)). 1975. 18p. (CE—02235). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A simple windmill theory is presented for designing a small, horizontal axis windmill for powering an automobile-type generator used along with a storage battery. Windmills designed by the method presented in this paper have maximum efficiencies in the order of 0.40 to 0.45, which approaches 75% of the theoretical maximum. Wind tunnel tests were performed on a two-bladed unit designed for a tip speed/wind speed ratio of 7. Maximum efficiency was close to 0.45 at a tip speed/wind speed ratio of slightly over 6. This windmill, if fitted directly to a specially wound three-brush automobile type generator, wil begin to charge a 6-volt battery at a wind speed of 7.5-8 mph. 2 refs., 7 figs., 1 tab.

14623 **(NEI-FI—69) Profitability of MW-class wind turbines in Finland.** Eloranta, J.; Koponen, K. (Rauma-Repola Oy (Finland). Pulp and Paper Mill). (Rauma-Repola Oy (Finland). Pulp and Paper Mill). Oct 1987. 75p. (In Finnish). NTIS (US Sales Only), PC A04. Order Number DE88756285/JAW.

This feasibility study tries to describe the use of wind energy as a part of Finnish energy supply and to evaluate the possible export market potential. For these purposes preliminary design of 850 kW wind turbine was performed. Wind energy potential in Finland, using the 850 kW turbine, is about 5-7 TWh/a depending on available land area. The turbines would locate in coast areas. The price level of wind energy on today's level of experience is 33-47 p/kWh. These figures include considerable development potential. Amount of 850 kW turbines would be about 4600-6400 pieces and the total power rating 3900-5400 MW. Globally maximum wind energy potential could be 150-300 TWh (= 1-2% of electricity production) in the year 2000. At the end of paper proposals for possible future development programmes are stated.

14624 **(NP—9770211) Voith WEC 520 wind power plant - long-time test. Final report.** Banzhaf, H.U.; Spittler, W. (Voith (J.M.) G.m.b.H., Heidenheim (Germany, F.R.). Geschaeftsbereich Antriebstechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 8 Jul 1986. 116p. (In German). NTIS (US Sales Only), PC A06. Order Number DE89770211/JAW.

The BMFT-supported three years long-time test on the Stoetten Voith field testing premises entitled ET 4513 A, aerodynamic and vibrational measurement of the WEC 300 Voith wind energy converter (Voith WEC 520 today) was dedicated to WEC 520 tests and practical experiences. The problems occurring during testing were solved step by step in the course of time. Although the WEC 520 long-time test gave proof of the feasibility of an automatic unmanned operation of wind power plants of this very size series construction licenses will be requiring further testing. The report deals with damaged rotor blades and their repair, the development of systems controlling the start of blades, operational problems, the optimization of control mechanisms, and the long-time test results.

14625 **(NRC—7903) Magdalen Islands VAWT field test.** South, P.; Watts, A. (National Research Council of Canada, Ottawa, Ontario; Institut de Recherche d'Hydro-Quebec, Varennes (Canada)). 1979. 32p. (CE—02210). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An experimental vertical axis wind turbine, 37 m high and 24 m in diameter, was installed on the Magdalen Islands to power a 224 kW generator connected to the local electric grid. The turbine has been operated at up to ca 80% of design speed. This paper reports on operation and performance of the turbine, and its impact on the local environment. An appendix describes the accident in 1978 which destroyed the turbine, and caused by an uncoupling of the mechanical drive train and failure of the aerodynamic spoilers. Detailed description is made of the extent of the damage, notably to the rotor, which was the only extensively damaged component of the system. Recommendations are presented for the design, construction, and operation of a rebuilt rotor at the site. 10 figs.

14626 **(NRC—7904) Design characteristics of the 224 kW Magdalen Islands VAWT.** Templin, R.J. (National Research Council of Canada, Ottawa, Ontario). 1979. 11p. (CONF-7904111—; CE—02252). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

A 120-ft high vertical axis turbine, operated as a demonstration project in the Magdalen Islands 1977-78, is described with respect to the factors that affected the initial choice of basic design parameters. Although the turbine's Darrieus-type rotor was destroyed in an accident, the basic integrity of the design was demonstrated and the rotor is being rebuilt with only minor modifications. The design parameters discussed in this report are the blade structure, number of blades, rotor height/diameter ratio, turbine swept area, use of blade spoilers, blade strut design, and type of alternator. Since no computerized structural analysis methods applicable to the dynamic analysis of large turbines were available at the time, it was decided to base the dynamic analysis on a series of aeroelastic wind tunnel model tests. The report also summarizes these tests and suggests some items for future research. 4 refs., 3 figs.

14627 **(RISO-M—2546) Wind turbine test. Wind Matic WM 17S.** Friis Pedersen, T. (Risoe National Lab., Roskilde (Denmark)). Apr 1986. 87p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756291/JAW.

The report describes standard measurements performed on a Wind-Matic WM 17S, 75 kW wind turbine. The measurements car-

ried out and reported here comprises the power output, system efficiency, energy production, transmission efficiency, rotor power, rotor efficiency, air-brakes efficiency, dynamical behaviour of the turbine, loads at cut-in and braking, rotor torque at stopped condition, and noise emission.

14628 **(STEV-VIND—88-26) Fatigue design of large wind energy conversion systems and operational experience from the Swedish prototypes.** Blom, A.F.; Svenkvist, P.; Thor, S.E. (Statens Energiverk, Stockholm (Sweden); Flygtekniska Foersoeksanstalten, Stockholm (Sweden). Structures Dept.). May 1988. 50p. (CONF-8803187—1; FFA-TN—1988-25). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756299/JAW.

From Workshop on fatigue in wind turbines; Harwell, UK (21 Mar 1988).

A summary of the Swedish experience concerning fatigue problems in large wind energy conversion systems (WECS) is given in this paper. The two prototypes, Naesudden and Maglarp, are discussed with emphasis on blade related topics for the steel and glass fibre composite blades, respectively. The topics include loads, fatigue design, material properties, structural testing, inspection procedures and environmental effects. In-service fatigue related experience during five to six years of operation is discussed in the light of the above topics. (authors).

14629 **(STEV-VIND—88-27) FFA - Basic knowledge concerning wind power. Suggestions for continued activities during stage 11, July 1988 to June 1989.** Gustafsson, A.; Thor, S.E. (Aeronautical Research Inst. of Sweden, Bromma). (Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma). Aug 1988. 46p. (In Swedish). (FFAP—200). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756300/JAW.

The activities during stage 10 are reported, covering wind measurement, verification of mathematical models, aerodynamics, material problems, safety etc. The proposed operations are estimated to involve the cost of 9 MSEK. (G.B.).

14630 **(STEV-VIND—88-29) Design and evaluation of an autonomous wind-diesel system.** Holmblad, L.; Linders, J.; Andersson, B. (Statens Energiverk, Stockholm (Sweden)). Sep 1988. 44p. (CTH-R—88-01). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756301/JAW.

In this report the work of the development of an autonomous electrical supply system incorporating a wind turbine and a diesel-generator set is presented. The work resulted in an experimental autonomous wind-diesel system designed to supply a maximum load of 18 kW. It incorporates an energy storage system composed of lead-acid batteries and convertors. In the report the design and construction of the system and the results from the laboratory tests are described. The most important conclusions from the work are: * The use of specially designed convertors and an advanced control system has resulted in an integrated system, * Energy storage gives possibilities to high fuel savings and reduced diesel engine wear, * The system is complex and the investment costs are high compared to a system without energy storage, * The autonomous grid is not influenced by wind power fluctuations, and a voltage and frequency quality as good as for a standard diesel-generator can be achieved. (authors).

14631 **(STEV-VIND—88-30) Theoretical study of connection current on a twospeed wind power generator of the size 3/1.2 MW and an onespeed wind power generator of the size 3 MW connected to the electrical network of Gotland.** Nordqvist, P. (Statens Energiverk, Stockholm (Sweden)). 23 Sep 1988. 18p. (In Swedish). (CTH-R—88-06). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756302/JAW.

The report consists of computer calculations on a twospeed generator in the size 3/1.2 MW and an onespeed generator in the size 3 MW connected to the electrical network of Gotland.

14632 **(STEV-VIND—88-31) Theoretical study with a computer based calculation model of effect oscillations from the windpower mill of Naesudden.** Nordqvist, P. (Statens Energiverk, Stockholm (Sweden)). 23 Sep 1988. 28p. (In Swedish). (CTH-R—88-05). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756303/JAW.

Contents of report: Theoretical survey with a calculation model of effect oscillations from the windpower mill of Naesudden. The report consists of computer calculations with direct connection of the windpower mill to the electrical network of Gotland and a simulation with reference to step response has also been performed. The calculation model is described, with the same theory as for DQ machines. A number of connection methods have also been described.

14633 **The status of the vertical axis wind turbine research test bed.** Dodd, H.M. Jr. (Wind Energy Research Division, Sandia National Laboratories, Albuquerque, NM (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

The Sandia National Laboratories has designed, procured, and is presently erecting in Bushland, Texas, a Vertical Axis Wind Turbine (VAWT) research Test Bed in order to develop and demonstrate the improved technologies necessary for the next generation of commercial VAWTs. Of particular interest are the significant improvements predicted by analytical models in the areas of aerodynamic performance, structural dynamics, fatigue life and control strategies. The Test Bed is specifically designed to be a modular research tool rather than a commercial prototype unit; however, the research seeks to directly impact the cost of energy through increased energy capture, more efficient structures (i.e., lower initial cost), increased component lifetimes and improved operating procedures. As is befitting research hardware, the Test Bed is heavily instrumented in order to precisely define its performance and to accurately record the impact of various hardware and operational changes.

14634 **Studies of the wake of a DAF 500-KW vertical axis wind turbine at Southern California Edison's wind energy test facility.** Renne, D.S.; Buck, J.W.; Wehrey, M.J. (Battelle, Pacific Northwest Labs., Richland, WA (US));. pp v of Proceedings of the wind energy expo '86 and national conference. Alexandria, VA; American Wind Energy Assoc. (1987). (CONF-860942—).

From 16. American Wind Energy Association national conference and 5. wind energy expo '86; Cambridge, MA, USA (1 Sep 1986).

Southern California Edison Company (SCE), with support from the Electric Power Research Institute (EPRI), has been testing and evaluating the DAF 500 vertical-axis wind turbine (DAF 500 WT) installed at SCE's Devers Substation near San Gorgonio Pass, California. One aspect of this testing is to develop an understanding of the wake characteristics of this particular machine so that lateral and downwind spacing guidelines for wind-turbine arrays can be developed. Two field experiments funded by SCE and EPRI have been conducted by Battelle, Pacific Northwest Laboratories, to characterize the wake of the DAF 500 WT. This study was designed to extend the essential information gathered in the Phase I study to the greater downwind distances more like actual turbine spacing.

14635 **Wind energy resource assessment activities in Egypt.** Renne, D.S.; Elliott, D.L.; Holst, B.D.; El-Bassounyi, K. (Battelle, Pacific Northwest Labs., Richland, WA (US));. pp v of Proceedings of the wind energy expo '86 and national conference. Alexandria, VA; American Wind Energy Assoc. (1987). (CONF-860942—).

From 16. American Wind Energy Association national conference and 5. wind energy expo '86; Cambridge, MA, USA (1 Sep 1986).

The Government of Egypt (GOE), jointly with USAID/Cairo, is conducting a renewable energy field testing program in an effort to determine the feasibility of supplementing conventional sources of energy with renewable sources. Wind energy is just one

of the renewable energy sources that is being tested in this program. A feasible wind energy resource has long been recognized in certain regions of Egypt. An important step in the current field testing program is quantifying the extent of Egypt's wind resources using existing data. The existence of this resource is then verified through onsite wind monitoring at key locations where wind energy applications are feasible. This paper summarizes these two activities that have been conducted jointly by Battelle, Pacific Northwest Laboratories (under sponsorship of USAID/Cairo) and the Egyptian Electricity Authority (EEA).

20 ELECTRIC POWER ENGINEERING

14636 **(EPRI-EL—6037-M-Vol.1) Security enhancement system: Volume 1, Software description and host utility demonstration: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); ESCA Corp., Bellevue, WA (USA)). Dec 1988. 63p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89007018/JAW.

Security Enhancement System (SES) is a set of integrated network analysis software programs that provides a means for improving system security and economic operation. SES consists of two major functions; Contingency Analysis and Security Enhancement. Contingency Analysis examines the effects of selected contingencies on system operating conditions. Contingencies are the loss of one or more network components (i.e., transmission lines, transformers, and generators), or the opening and closing of switching devices. Contingency Analysis provides information about those outages, identifying which will cause violations of the operating limits of equipment or of the system, and cause system separation or isolation of load or generation. Security Enhancement recommends corrective actions to alleviate thermal and voltage violations, e.g., rescheduling real power generation, committing and operating fast start units, changing phase shift angles and transformer taps, switching shunt capacitors and reactors, changing generator regulated voltages, and switching bus tie lines and breakers. Security Enhancement recommends corrective actions for existing violations. Corrective and preventive actions are developed for contingencies found to cause violations during Contingency Analysis. Recommendations are based on the least cost set of control actions required for alleviating violations. Advanced techniques were developed during the project for determining the external model, contingency screening, and network reduction. Models used throughout SES were derived from the fast-decoupled power flow techniques that allow SES to be used in real-time. SES can also be used in the study mode to study network changes and contingencies. 26 refs., 7 figs.

14637 **(EPRI-P—6211) The EPRI regional systems database: Version 3.0: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); COECORP, Mountain View, CA (USA)). Jan 1989. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006850/JAW.

The 1981 EPRI Regional Systems (ERS) database and its 1977 predecessor provided data on individual generating units for use with utility system planning models. An alternative approach, the regionalized electricity model (REM) computer code, aggregated generating capacity by fuel type. Changes in projected customer loads during the 1970s and early 1980s markedly affected utility construction plans: as customer load growth declined, utilities deferred or canceled many new generating units and implemented conservation and load management programs. The current revision of ERS reflects these changes and provides a basis from which to assess the effects of further changes in the utility industry. To update the 1981 ERS database, the project team drew on several sources to update the 1981 ERS database. The team obtained fossil and nuclear steam-generating unit data from the Utility Data Institute's EEI Power Statistics database. They derived end-use loads from synthesized load-shape data provided by Association of Edison Illuminating Companies and developed financial information by modeling data extracted from COMPUSTAT II{trademark} tapes. The team calibrated generation additions, load growth, and unit outage rates to NERC data. 11 refs., 15 figs., 35 tabs.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 14150, 14163, 14163, 14163, 14164, 14164, 14164, 14231, 14231, 14255, 14278, 14279, 14279, 14654, 14750, 15088, 15706

14638 **(EPRI-AP—5956-Vol.1) Utility gas turbine combustor viewing system: Volume 1, Conceptual design and initial field testing: Final report.** Morey, W.W. (Electric Power Research Inst., Palo Alto, CA (USA); United Technologies Research Center, East Hartford, CT (USA)). Dec 1988. 142p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006055/JAW.

This report summarizes the development and field testing of a combustor viewing probe (CVP) as a flame diagnostic monitor for utility gas turbine engines. The prototype system is capable of providing a visual record of combustor flame images, recording flame spectral data, analyzing image and spectral data, and diagnosing certain engine malfunctions. The system should provide useful diagnostic information to utility plant operators, and reduce maintenance costs. The field tests demonstrated the ability of the CVP to monitor combustor flame condition and to relate changes in the engine operation with variations in the flame signature. Engine light off, run up to full speed, the addition of load, and the effect of water injection for NO/sub x/ control could easily be identified on the video monitor. The viewing probe was also valuable in identifying hard startups and shutdowns, as well as transient effects that can seriously harm the engine. 11 refs.

14639 **(EPRI-AP—5956-Vol.2) Utility gas turbine combustor viewing system: Volume 2, Engine operating envelope test: Final report.** Morey, W.W. (Electric Power Research Inst., Palo Alto, CA (USA); United Technologies Research Center, East Hartford, CT (USA)). Dec 1988. 74p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006057/JAW.

This report summarizes the development and field testing of a combustor viewing probe (CVP) as a flame diagnostic monitor for utility gas turbine engines. The prototype system is capable of providing a visual record of combustor flame images, recording flame spectral data, analyzing image and spectral data, and diagnosing certain engine malfunctions. The system should provide useful diagnostic information to utility plant operators, and reduced maintenance costs. The field tests demonstrated the ability of the CVP to monitor combustor flame condition and to relate changes in the engine operation with variations in the flame signature. Engine light off, run up to full speed, the addition of load, and the effect of water injection for NO/sub x/ control could easily be identified on the video monitor. The viewing probe was also valuable in identifying hard startups and shutdowns, as well as transient effects that can seriously harm the engine.

14640 **(EPRI-CS—6048) Proceedings: 1987 conference on fossil plant cycling.** Dixon, R.R. (ed.); Smith, L.P. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA); TRAX Corp., Lynchburg, VA (USA)). Dec 1988. 690p. (CONF-871094—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89005223/JAW.

From Conference on fossil plant cycling; Princeton, NJ, USA (20 Oct 1987).

An EPRI workshop to address fossil plant cycling was hosted by Public Service Electric & Gas in Princeton, New Jersey, October 20-22, 1987. Participants represented a broad spectrum of US and foreign utilities, architect-engineering firms, equipment vendors, engineering consultants, and universities. These Proceedings contain the text of the formal presentations as well as summaries of the working group sessions and the panel discussion. The formal presentations addressed six broad topics including: generation planning; turbine and balance of plant modifications; boiler modifications; plant analysis and design modifications; controls, operating procedures, and maintenance; and monitoring cycling plants. Four working group sessions were held to provide a forum for participants to discuss specific cycling related issues in more detail including: diagnostics and monitoring; controls, operating procedures, and maintenance; generation planning, operations and maintenance, and controls; and plant design changes.

14641 (EPRI-CS—6068) Control of fan erosion in coal-fired power plants, Phase 2: Final report. Sverdrup, E.F.; Albertin, L.; Chamberlin, R.M.; D'Amico, N.J.; El Masri, M.A.; Glasser, A.D.; Menguturk, M.; Rane, A.; Racki, R.; Petlevich, W.J. (Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center; Westinghouse Electric Corp., Hyde Park, MA (USA). Sturtevant Div.). Nov 1988. 356p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89004689/JAW.

The Electric Power Research Institute contracted with Westinghouse to address the problems electric utilities experience caused by fan erosion. The objective of this phase of the research program was to understand how to control erosion damage to coal-fired power plant fans by: Developing fan design modifications that raise the tolerance of fans to fly-ash erosion and that simultaneously improve fan performance. Understanding why fly ashes vary in their erosivities and developing the ability to predict the erosivity of the fly ash from core borings of the fuel to be fired; Evaluating the performance of erosion protection systems we have installed on a number of fans suffering severe fly-ash erosion damage; Developing a method to armor centrifugal fans against fly-ash erosion while providing for easy field replacement of the blade liners; and Developing a computer model that calculates particle trajectories through the inlet box of a fan. 18 refs., 74 figs., 18 tabs.

14642 (EPRI-GS—6156) Major options and considerations for repowering with gas turbines: Final report. Kudlu, N. (Electric Power Research Inst., Palo Alto, CA (USA); Bechtel Group, Inc., San Francisco, CA (USA)). Jan 1989. 75p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006674/JAW.

This report is based primarily on the findings of the previously published EPRI reports on several conceptual but site-specific repowering investigations. The report describes five major options available for repowering existing fossil-fueled power plants utilizing combustion turbines. For each option, it describes a typical conceptual design, major requirements for new and reused existing equipment, improvement in performance, capital cost, and project schedule. It also provides a brief description of the major issues to be addressed by the utilities related to siting, plant emissions, licensing, and cycle optimization. The report is intended to provide the utility industry with broad guidelines on repowering investigations. 6 refs., 7 figs., 1 tab.

14643 (LUTFD2/TFRT—3191-1-52-1987) Simplified models of boiler-turbine units. Bell, R.D.; Aastroem, K.J. (Lund Univ. (Sweden). Dept. of Automatic Control). Dec 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756272/JAW.

Two simple models to represent the dynamics of fossil-fueled boiler-turbine units are derived in this report. These models are an extension of the work of Morton and Price (1977) and rely heavily on data and model developments presented in Eklund (1971), Aastroem and Eklund (1972, 1975) and Bell and Aastroem (1979). The major contributions of these models is in the prediction of drum water level. The swell/shrink phenomena is quite accurately captured even though the models are only of third order. Step responses and a comparison to plant data are presented to validate the performance of the models. Program listing for the SIMNON system simulation language and the method used to calculate all unknown parameters in the models for a 160 MW unit are given. (authors).

14644 (LUTFD2/TFRT—3192-1-137-1987) Dynamic models for boiler-turbine-alternator units: Data logs and parameter estimation for a 160 MW unit. Bell, R.D.; Aastroem, K.J. (Lund Univ. (Sweden). Dept. of Automatic Control). Dec 1987. 138p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756273/JAW.

The report outlines a number of non-linear models that have been developed for simulation of fossil-fueled boiler-turbine-alternator units. The development, physical basis and parameter estimates of these models are given. The emphasis in this work has been to capture the essential dynamic features of the boiler-turbine-alternator unit within the smallest possible number of equations. An extensive set of data collected from a 160 MW oil fired unit is included, and a comparison of the responses of some of the models to this plant data is made. An IBM formatted floppy disc is available to more easily gain access to the models and data in this report. (authors).

14645 (PNL-SA—15932) A flexible end-use-based forecasting and conservation assessment tool. Englin, J.E.; DeSteese, J.G.; Kellogg, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 6p. (CONF-8811148—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005618/JAW.

From 3. national conference on microcomputer applications in energy; Tucson, AZ, USA (1 Nov 1988).

A software tool is described that was developed by Pacific Northwest Laboratory to conduct a Conservation-in-Lieu-of-Construction Study for Bonneville Power Administration. The specific study objective was to assess the potential for end-use load management to defer the need for new transmission capacity in areas experiencing electric load growth. The software was based on a commercially available time-series modeling package and was designed for use with an IBM-compatible personal computer. The model is modular and capable of modeling the commercial, industrial and residential sectors separately, or in aggregate. Operation of the model, exercise of a test case, and representative analytical results are described. The test case exercise validated the model's capability and indicated that appropriate load management measures can cost-effectively defer the need for new transmission capacity in such cases. 2 refs., 4 figs.

14646 (STEV-VK—88-5) Coordinated optimization of cogeneration plants and energy storage. Cronholm, L.Aa.; Oestergren, A. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). 5 Sep 1988. 168p. (In Swedish). (STUDSVIK-ED—88-24; STUDSVIK-ED—87-18). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756304/JAW.

The maximum justifiable investment for a seasonal storage which is optimized in respect to cogeneration is compared with estimated investment cost for different types of storage. For systems of around 300 MW/sub th/ or larger converted oil storage caverns could be profitable. If fuel taxes are taken into account, the investment potential is increased by about 27%. (G.B.).

14647 Heat pump ground coil analysis with thermal interference. Mei, V.C. (Oak Ridge National Lab., Oak Ridge, TN (US));. *Journal of Solar Energy Engineering;* **110**: No. 2, 67-73(May 1988).

When two horizontal ground coils are buried in the same trench, one on top of the other, the total energy exchange between coils and ground increases drastically over that of a single coil for the same trench length. However, because of the thermal interference between the two coils, the overall performance of the two-coil trench is very difficult to determine. Traditionally this type of problem is handled by the line source mirror-image approach. However, in applying the line source approach, the strength of the source is not known precisely and must be estimated. Most designers will estimate this value very conservatively in order to be on the safe side, and this will result in a longer coil than is actually needed. This paper provides a detailed mathematical model to describe the operation of the two-coil system that can calculate more realistically the performance of the ground coils, which in turn could make the ground coil heat pump system more economically competitive with other heating and cooling systems. This model is better than the line source approach for calculating the performance of two coils in the same trench. It can be used for design purposes, or used to check such coil designs by other methods.

14648 A direct method for transient stability analysis of power systems with detailed models. Sauer, P.W.; Behera, A.K.; Pai, M.A. (Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)); Winkelman, J.R. (Ford Motor Co., Dearborn, MI (US)); Chow, J.H. (Rensselaer Polytechnic Institute, Schenectady, NY (US));. *Electric Machines and Power System;* **15**: No. 1, 1-16(1988).

This paper presents a direct method for studying transient stability of multimachine systems with detailed models. The method uses a differential equation to define a general energy function. An algorithm is given for using the method with detailed models that contain fast dynamics.

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REFER ALSO TO CITATION(S) 14124, 14223, 14224, 14225, 14226, 14228, 14230, 14232, 14233, 14236, 14237, 14238, 14277

14649 (EPRI-EA—6095-Vol.2) A hierachy of dynamic plume models incorporating uncertainty: Volume 2, Stack Exhause Model (SEM): Final report. Sykes, R.I.; Lewellen, W.S.; Parker, S.F.; Henn, D.S. (Electric Power Research Inst., Palo Alto, CA (USA); California Research Technology, Princeton, NJ (USA). ARAP Div.). Jan 1989. 85p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006675/JAW.

The Stack Exhaust Model (SEM) is the highest resolution member of a hierarchy of models that predict the mean of time-averaged sampler observations downwind of a fossil-fueled power plant stack, along with an estimate of the variation about this mean. To represent the turbulent atmosphere surrounding the plume compatibly with available meteorological data, a second order closure sub-model is used. The purpose of SEM, which explicitly accounts for all major plume processes, is to provide a standard against which to evaluate more approximate models. SEM was tested against seven hours of plume data; approximately 200 samplers were used. Model predictions were evaluated by comparing the measured ground level concentration distribution to that predicted by the model. Another comparison was made for the distribution of differences between the sample values and modeled mean values. For five of the hours there were ground impacts, and the predicted distributions were close to the measured ones. For the other two hours, the model correctly predicted that the plume stayed aloft, and the predicted plume shape, size, tilt and details of internal plume concentration were close to those measured remotely by SO_2 differential absorption lidar. SEM requires intensive computation. Its greatest value is expected to be as a diagnostic tool with which to better understand the dynamics of plume diffusion near the stack and thus improve the parameterization of less computer-intensive models. 18 refs., 33 figs.

14650 (EPRI-EA—6095-Vol.3) A hierarchy of dynamic plume models incorporating uncertainty: Volume 3, Second-Order Closure Integrated Model Plume (SCIMP): Final report. Sykes, R.I.; Lewellen, W.S.; Parker, S.F.; Henn, D.S. (Electric Power Research Inst., Palo Alto, CA (USA); California Research Technology, Princeton, NJ (USA). ARAP Div.). Jan 1989. 173p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006847/JAW.

The Second Order Closure Integrated Model Plume (SCIMP) is the lowest resolution member of a hierarchy of models. It simulates the expected value of plume concentration downwind of a fossil-fueled powerplant stack, along with an estimate of the variation around this value. To represent the turbulent atmosphere surrounding the plume compatibly with available meteorological data, a second order closure sub-model is used. Plume expansion is calculated by a steady-state bivariate Gaussian model derived from cross-wind area integrals of the equations used in the Stack Exhaust Model (SEM), the highest resolution model. Meteorological uncertainty is accounted for by repeatedly running the model while randomly varying meteorological inputs. SCIMP was tested against approximately 500 hours of plume data including a level site and a moderately complex terrain site; approximately 200 samplers were used. Model predictions were evaluated by comparing the measured ground level concentration distribution to that predicted by the model. Further, the distribution of deviations between observed and expected values was compared to that simulated by the model. The predicted distributions were close to the measured ones. SCIMP is a practical tool, even though its detailed treatment of turbulence and its Monte Carlo treatment of meteorological uncertainty makes it more expensive than traditional Gaussian plume models. The reward for the additional complexity is the ability to establish confidence intervals around modeled concentration values. 12 refs., 19 figs., 11 tabs.

14651 (EPRI-EA—6095-Vol.4) A hierarchy of dynamic plume models incorporating uncertainty: Volume 4, Second-order closure integrated puff: Final report. Sykes, R.I.; Lewellen, W.S.; Parker, S.F.; Henn, D.S. (Electric Power Research Inst., Palo Alto, CA (USA); California Research Technology, Princeton, NJ (USA). ARAP Div.). Jan 1989. 110p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006846/JAW.

The Second Order Closure Integrated Puff Model (SCIPUFF) is the intermediate resolution member of a hierarchy of models. It simulates the expected values of plume concentration downwind of a fossil-fueled power plant stack, along with an estimate of the variation around this value. To represent the turbulent atmosphere surrounding the plume compatibly with available meteorological data, a second order closure sub-model is used. SCIPUFF represents the plume by a series of Gaussian puffs, typically 10 seconds apart; plume growth is calculated by a random walk phase combined with plume expansion calculated from the volume integrals of the equations used in the Stack Exhaust Model (SEM), the highest resolution model. Meteorological uncertainty is accounted for by means of extra dispersion terms. SCIPUFF was tested against more than 250 hours of plume data including both a level site and a moderately complex terrain site; approximately 200 samplers were used. Model predictions were evaluated by comparing the measured ground level concentration distribution to that simulated by the model. Further, the simulated and actual distributions of deviations between simulated or observed and expected values were compared. The predicted distributions were close to the measured ones. The overall results from SCIPUFF were similar to those from the lowest resolution model, SCIMP. The advantage of SCIPUFF is its flexibility for including future improvements. When combined with a suitable mesoscale model, SCIPUFF may be able to simulate plume dispersion beyond the 50 km limit of other available models. The ability to cover a wide range of time and space scales in a single calculation is another valuable feature. 3 refs., 10 figs., 4 tabs.

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REFER ALSO TO CITATION(S) 14998

14652 (EPRI-EL—6197) Fumigant effectiveness in creosote- and penta-treated southern pine poles. Wang, C.J.K.; Terracina, F.C.; Zabel, R.A. (Electric Power Research Inst., Palo Alto, CA (USA); State Univ. of New York, Syracuse (USA). Coll. of Environmental Science and Forestry). Jan 1989. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006679/JAW.

The objectives were to evaluate the effectiveness of the fumigants, Vapam and chloropicrin, to arrest decay development in the groundline zone of southern pine poles, and to determine the types and prevalence of fungi reinvading the poles after fumigation. Fifty-one creosote- and penta-treated poles representing various service ages and decay conditions were fumigated with Vapam or chloropicrin. Cores were extracted from the groundline zone for fungus isolations and decay determinations, prior to fumigation and annually thereafter for 8 years. The reappearance of decay fungi was the major criterion used for judging fumigant effectiveness. Both Vapam and chloropicrin were effective disinfectants and killed all of the previously detected fungi in all poles. The protection periods of the fumigants from decay fungus reinvasions varied with pole age, prior decay condition, and preservative treatment. They ranged from less than 1 to 7 years and were least in older poles with prior decay. Soft-rot fungi were major decay agents which reinvaded the fumigated poles. The reinvading fungi were generally those tolerant to the preservatives or fumigants used in the study. Chloropicrin concentrations at 5, 6, and 7 years after fumigation were highly variable, and below toxic threshold levels in the outer core zones of most poles. 33 refs., 4 figs., 12 tabs.

14653 (VTT-TIED—883) Knowledge-based system for real-time operation planning and event analysis in power system control. Keronen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Laboratorio). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1988. 111p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756312/JAW.

The aim was to develop a knowledge-based system for real-time operation planning in a power system control centre. During the study a prototype system called EKA was developed for the power system of the Helsinki Energy Board. The prototype is implemented with object-oriented techniques and it includes a complete model of the 110 kV transmission network and knowledge for the generation and testing of switching sequences. The study demonstrated that the solution method is suitable for the problem. The use of the expert system reduces routine work of the operators and gives them more time to think about the real problems. The major advantages of the system are the easiness of the user interface and the domain-oriented representation of the network. The flexibility of the system also surprised the developers and the users. The use of KEE and Common-Lisp were perfectly suited to the problem. With objects, rules, methods, demons and lisp-functions, it was easy to describe the electric network, relations in it, its behavior and the knowledge needed for switching operations. Although the development has been successful on the theoretical side, some severe practical problems exist. First, the current system is too slow to be used for real-time purposes. Second, the lack of editors and documentation methods has caused trouble and much extra work. We hope that, in the future, the problem could be solved with more sophisticated editors and documentation protocols. The next step in the project is to convert the system to be used as a training simulator and test and develop the knowledge base. At the same time the studies of the event analysis will be started. According to our plan, both systems will be installed in the control centre in 1990 or 1991.

14654 Applications of superconductors to electric motors. McConnell, B.W. (Energy Division, Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

This paper reviews previous experience in applying superconductors to electric motors and examines the difficulties encountered. While motors and generators have a common basis, several significant differences exist. The application of high temperature superconductors to the major electric motor types is discussed and expected difficulties are presented. The limitations imposed by various motor designs are reflected in a statement of the desired material properties for high temperature superconductor electric motor applications.

14655 Conductor loss in superconducting power transmission cables. Forsyth, E.B. (Brookhaven National Lab., Associated Universities Inc., Upton, New York, NY (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

An analytic solution for the hysteretic loss in a Type II superconductor has been derived which is analogous to hysteretic loss in ferromagnetic materials subjected to weak alternating fields. In practice the losses in a practical conductor design are increased above the intrinsic loss due to such effects are grain size, surface roughness and the addition of other metallic components. The choice of conductor configuration also affects the losses. Flexible conductors, for example, exhibit further loss mechanisms due to circulating currents and proximity effects. Quantitative results are compared with theory.

14656 Independent real and reactive power control with superconductive magnetic energy storage. Wang, J.; Skiles, J.J.; Kustom, R.L.; Cleary, J.; Tsang, F. (Univ. of Wisconsin-Madison, 1500 Johnson Drive, Madison, WI (US));. pp v of The 1987 IEEE Industry Applications Society annual meeting. Parts 1 and 2. Conference record. Piscataway, NJ; IEEE Service Center (1987). (CONF-871065—).

From 22. IEEE/IAS annual meeting; Atlanta, GA, USA (19 Oct 1987).

The power conditioning circuits to interface a diurnal load-leveling superconductive magnetic energy storage (SMES) coil to a power utility network can be 6-mutiple pulse gate controlled SCR or gate-turn-off (GTO) device bridges. One desirable characteristic of the power conditioning circuits is that they should be able to provide independent real and reactive power control. A possible solution to this requirement is to use combinations of SCR and GTO bridges. At GTO bridge circuit has been proposed for this purpose. For fast online feedback control of real and reactive power flow of SMES, a digital power measuring technique has been developed to rapidly measure the real and reactive power flow.

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REFER ALSO TO CITATION(S) 14817, 15712

14657 (CNEA-NT—40/87) Progress report 1985-1986 Reactor Chemistry Department. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Dec 1987. 300p. (In Spanish). NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88705320/JAW.

The report of the activities performed by the Reactor Chemistry Department of the National Atomic Energy Commission, during the period 1985-1986, covers works of investigation, development and service related to the Argentine Nuclear Power Plants. The main subjects are the experimental and theoretical studies about physical chemistry and chemistry control at the moderators and heat transport system of the nuclear power plants. The more relevant topics are related to: 1: Behaviour of gases, electrolites and other additives for nuclear power plants, at high temperature and pressure; 2: Ionic exchangers of nuclear degree; 3: Electrochemistry studies connected with the constitutive materials' corrosion and with the nuclear power plants decontamination processes; 4: Behaviour of suspensions and colloids in nuclear power plants; 5: Use of new additives for chemistry control of the oxides which are in the circuits of nuclear power plants; 6: Research methods that allow to check reactor's control quality; 7: Study of the radiolytic behaviour of nuclear reactor's solutions. (M.E.L.).

14658 (EPRI-NP—6152-Vol.1) Demonstration of reliability-centered maintenance: Volume 1, Project description. (Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1989. 44p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89007015/JAW.

Reliability centered maintenance (RCM) is an approach to preventive maintenance planning and evaluation that has been used successfully by other industries, most notably airlines and the military. Now EPRI is demonstrating RCM in the commercial nuclear power industry. Currently underway are large-scale, two-year demonstrations at Rochester Gas and Electric (Ginna nuclear power station) and Southern California Edison (San Onofre generating station). Both demonstrations were begun in the spring of 1988. At each plant, RCM will be performed on 12 to 20 major systems. The purpose of both demonstrations is to determine whether RCM is an appropriate means to improve nuclear plant preventive maintenance on a large scale. Such favorable results had been suggested by three earlier EPRI pilot studies at Florida Light and Power Company, Duke Power Company, and Southern California Edison. However, it still needs to be proven that RCM, when applied to major plant systems at an operating plant, is both cost effective and compatible with other plant operations and organization. EPRI selected the Ginna and San Onofre sites because, together, they represent a broad range of utility and plant size, plant organization, plant age, and histories of availability and reliability. Significant steps in each demonstration include: selecting and prioritizing plant systems for

RCM evaluation; performing the RCM evaluation steps on selected systems; evaluating the RCM recommendations by a multidisciplinary task force; implementing the RCM recommendations; establishing a system to track and verify the RCM benefits; and establishing procedures to update the RCM bases and recommendations with time. Thus far, RCM appears to be a promising adjunct to a plant's preventive maintenance program. The two large-scale demonstrations will answer further questions and perhaps bring the nuclear industry closer to widespread application of RCM. 13 refs., 4 figs., 2 tabs.

14659 (IAEA-TC—560.02, pp 11-16) **IAEA activities in computer aided safety analysis - present status and future prospects.** Almeida, C. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The IAEA Programme on Computer Aided Safety Analysis is presented together with the statistics of computer utilization under the programme. Difficulties encountered during programme implementation are discussed and a reformulation is proposed as a possible solution. (author). 1 ref., 5 figs, 2 tabs.

14660 **(NUREG—0020-Vol.12-No.12) Licensed operating reactors: Status summary report, data as of 11-30-88.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Jan 1989. 499p. NTIS, PC A21/MF A01 - GPO - OSTI. Order Number TI89005984/JAW.

The US Nuclear Regulatory Commission's monthly LICENSED OPERATING REACTORS Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information, such as spent fuel storage capability, reactor years of experience, and non-power reactors in the United States.

14661 **(NUREG—0020-Vol.13-No.1) Licensed operating reactors status summary report, data as of December 31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Feb 1989. 487p. NTIS, PC A21 - GPO - OSTI. Order Number TI89006945/JAW.

The US Nuclear Regulatory Commission's monthly LICENSED OPERATING REACTORS Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 14367, 14677, 14729, 14746, 14751, 14759, 14776, 14808, 14812, 14814, 14816, 14820, 14821, 14827, 14830

14662 **(CONF-881011—36) Benchmarking and qualification of the NUFREQ-NPW code for best estimate prediction of multi-channel core stability margins.** Taleyarkhan, R.; Lahey, R.T. Jr.; McFarlane, A.F.; Podowski, M.Z. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02 - OSTI. Order Number DE89006413/JAW.

From Joint meeting of the European Nuclear Society and the American Nuclear Society; Washington, DC, USA (30 Oct 1988).

The NUFREQ-NPW code was modified and set up at Westinghouse, USA for mixed fuel type multi-channel core-wide stability analysis. The resulting code, NUFREQ-NPW, allows for variable axial power profiles between channel groups and can handle mixed fuel types. Various models incorporated into NUFREQ-NPW were systematically compared against the Westinghouse channel stability analysis code MAZDA-NF, for which the mathematical model was developed, in an entirely different manner. Excellent agreement was obtained which verified the thermal-hydraulic modeling and coding aspects. Detailed comparisons were also performed against nuclear-coupled reactor core stability data. All thirteen Peach Bottom-2 EOC-2/3 low flow stability tests were simulated. A key aspect for code qualification involved the development of a physically based empirical algorithm to correct for the effect of core inlet flow development on subcooled boiling. Various other modeling assumptions were tested and sensitivity studies performed. Good agreement was obtained between NUFREQ-NPW predictions and data. Moreover, predictions were generally on the conservative side. The results of detailed direct comparisons with experimental data using the NUFREQ-NPW code; have demonstrated that BWR core stability margins are conservatively predicted, and all data trends are captured with good accuracy. The methodology is thus suitable for BWR design and licensing purposes. 11 refs., 12 figs., 2 tabs.

14663 **(EPRI-NP—6113-M) Thermal annealing of an embrittled reactor vessel: Feasibility and methodology: Final report.** Mager, T.R.; Lott, R.G. (Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Power Systems Div.). Jan 1989. 40p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006853/JAW.

The annealing and reirradiation response of irradiated pressure vessel weldments has been studied using microhardness techniques. Eight different weldments from nuclear pressure vessel surveillance programs were selected for study. Three weldments that were originally irradiated in a test reactor program and an A302B plate were also studied. The microhardness specimens were taken from Charpy specimens originally tested in the reactor pressure vessel surveillance programs. The Charpy specimens had experienced fast neutron fluences ranging from 2.5 x 10^{18} n/cm^2 to 8.84 x 10^{19} n/cm^2 (E>1 MeV) prior to the preparation of the microhardness specimens. The original fluences were determined by the availability of surveillance capsule material. Specimens were also prepared from unirradiated archive material. These specimens were then annealed for 168 hours (1 week) at temperatures ranging from 350{degree}C to 450{degree}C and then reirradiated in a test reactor. The test reactor reirradiations were performed in two capsules. The high fluence capsule was irradiated to a neutron fluence of 5.4 x 10^{19} n/cm^2, while the low fluence capsule was irradiated to 2.1 x 10^{19} n/cm^2. Microhardness measurements were performed at each stage of the process to monitor the annealing effectiveness and the benefits of annealing after long term reirradiation. The results of this study are provided in this report. A procedure for monitoring the embrittlement of an annealed pressure vessel is also outlined. This procedure is based on the benefit factor methodology developed for use in the model of embrittlement. Examples of how this procedure might be applied to a reactor vessel with a limited number of remaining surveillance specimens are provided. 3 refs., 6 figs., 2 tabs.

14664 **(EPRI-NP—6116) Proceedings: Main coolant pump diagnostics.** (Electric Power Research Inst., Palo Alto, CA (USA); Ontario Hydro, Toronto (Canada)). Dec 1988. 607p. (CONF-8803185—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89005516/JAW.

From Workshop on main coolant pump diagnostics; Toronto, Canada (29 Mar 1988).

Main Coolant Pumps (BWR recirculation pumps and PWR Reactor Coolant Pumps - RCP's) are large, single-stage, vertical pumps. RCPs have been required to be monitored for pump health. This has been accomplished using vibration monitoring. The inter-

pretation of this data, however, has not been completely understood. Recirculation pumps, in general, have not been monitored for pump health. Recent shaft cracks, bearing rubs, and other pump problems have shown that a better understanding of pump health would be of significant financial benefit to utilities. Consequently, a workshop was held March 29--31, 1988, in Toronto, Canada. The workshop was attended by representatives from utilities, NSSS suppliers, pump vendors, architect-engineers, consultants, universities, and the NRC. Proceedings of this workshop are contained in this report.

14665 **(IKE—5-225) Investigation on the thermal gap conductance between fuel and cladding of LWR fuel rods.** Tuan Nguyen-Minh. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Apr 1988. 136p. (In German). Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme.

The present work is concerned with the thermal gap conductance between fuel and cladding of light-water reactor fuel rods. First, available experimental data and models for predicting the thermal gap conductance are reviewed and compared. Uncertainties in the theoretical prediction are shown - especially of the gas extrapolation length and the accomodation coefficient. The well-known modulation method has been improved to determine the thermal gap conductance. The developed evaluation formalism, based on the Laplace transform, and the modified experimental set-up are described. Moreover, measurements on UO/sub 2//Zircaloy-samples are presented; the influence parameters surface roughness, gap width, gas composition, gas pressure and temperature have been systematically varied. Based on the experimental results, influences on the thermal gap conductance, the gas extrapolation length and the accommodation coefficient are quantified. The results - especially the determination of the accommodation coefficient in dependence of gas composition, gas pressure and temperature - add to the knowledge of the thermal gap conductance. Comparison with data of other authors contributes to the clarification of existing discrepancies in the literature.

14666 **(INIS-mf—11889) KWL annual report 1987.** (Kernkraftwerk Lingen G.m.b.H. (Germany, F.R.)). 1987. 22p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756808/JAW.

At the end of 1987, the work for preparing the safe enclosure of the reactor was completed, and on March 22, 1988 the supervisory authority gave permission to start operational activities for post-shutdown containment of the reactor, as of March 30, 1988. The personnel of KWL was reduced to 12 members in the reporting year. As financial reserves for decontamination and waste management, DM 14.6 millions were required, and DM 3.6 millions for reprocessing. The annual loss of DM 20.3 millions was compensated by VEW by mena of supplementary contributions. KWL also, as in previous years, contributed in 1987 to research projects of the European Commission (Euratom), the KWL programme covering the field of containment after decommissioning, and theoretical and experimental studies on the effects of ventilation and air-drying on activity release and corrosion in the plant.

14667 **(MIT-EL—87-004) International comparison of LWR performance.** Beckjord, E.; Golay, M.; Gytopoulos, E.; Hansen, K.; Lester, R.; Winje, D.K. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Feb 1987. Contract AC02-86NE37962. 325p. NTIS, PC A14/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006973/JAW.

This report summarizes the large body of data and other information collected as part of a study on the International Comparison of LWR Performance. The object of the study is to quantify the causes of lost capacity in nuclear power plants in the Federal Republic of Germany, France, Japan, Sweden, Switzerland, and the United States, and to understand why losses vary with time, as well as from country to country.

14668 **(NUREG/CR—4469-Vol.7) Nondestructive examination (NDE) reliability for inservice inspection of light water reactors: Semi-annual report, April--September 1987.** Doctor, S.R.; Deffenbaugh, J.D.; Good, M.S.; Green, E.R.; Heasler, P.G.; Simonen, F.A.; Spanner, J.C.; Taylor, T.T. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 85p. (PNL—5711-Vol.7). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89005753/JAW.

Evaluation and Improvement of NDE Reliability for Inservice Inspection of Light Water Reactors (NDE Reliability) Program at the Pacific Northwest Laboratory was established by the Nuclear Regulatory Commission to determine the reliability of current inservice inspection (ISI) techniques and to develop recommendations that will ensure a suitably high inspection reliability. The objectives of this program include determining the reliability of ISI performed on the primary systems of commercial light-water reactors (LWRs); using probabilistic fracture mechanics analysis to determine the impact of NDE unreliability on system safety; and evaluating reliability improvements that can be achieved with improved and advanced technology. A final objective is to formulate recommended revisions to ASME Code and Regulatory requirements, based on material properties, service conditions, and NDE uncertainties. The program scope is limited to ISI of the primary systems including the piping, vessel, and other inspected components. This is a progress report covering the programmatic work from April 1987 through September 1987. 11 refs., 44 figs., 3 tabs.

14669 **(PNL—6603) Status of rod consolidation, 1988.** Bailey, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 65p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007103/JAW.

It is estimated that the spent fuel storage pools at some domestic light-water reactors will run out of space before 2003, the year that the US Department of Energy currently predicts it will have a repository available. Of the methods being studied to alleviate the problem, rod consolidation is one of the leading candidates for achieving more efficient use of existing space in spent fuel storage pools. Rod consolidation involves mechanically removing all the fuel rods from the fuel assembly hardware (i.e., the structural components) and placing the fuel rods in a close-packed array in a canister without space grids. A typical goal of rod consolidation systems is to insert the fuel rods from two fuel assemblies into a canister that has the same exterior dimensions as one standard fuel assembly (i.e., to achieve a consolidation or compaction ratio of 2:1) and to compact the nonfuel-bearing structural components from those two fuel assemblies by a factor of 10 to 20. This report provides an overview of the current status of rod consolidation in the United States and a small amount of information on related activities in other countries. 85 refs., 36 figs., 5 tabs.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 14367, 14663, 14664, 14665, 14667, 14668, 14669, 14729, 14746, 14751, 14755, 14758, 14761, 14773, 14774, 14775, 14776, 14778, 14780, 14781, 14782, 14783, 14785, 14786, 14789, 14790, 14791, 14792, 14793, 14794, 14795, 14796, 14797, 14798, 14799, 14800, 14801, 14802, 14803, 14807, 14808, 14812, 14814, 14818, 14820, 14821, 14822, 14825, 14830, 14832

14670 **(CEA-CONF—9596) French administrative practice and design codes for nuclear vessels.** Roche, R.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 12p. (CONF-880962—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756412/JAW.

From 6. international conference on pressure vessel technology; Beijing, China (11 Sep 1988).

French codes for nuclear components are presented, emphasizing the conditions of practical use. They are strongly linked to French regulations and the first part of the paper is devoted to presentation of these regulations and to the ways they are applied by authorities. The most important part is the decree of February

26, 1974 which defines the frame for codes and standards. Two codes are presented. The first one is dealing with components for water cooled nuclear boilers (RCC-M) and the second with components of Fast Breeder Reactors.

14671 **(CEA-CONF—9650) Design criteria for piping components against plastic collapse application to pipe bend experiments.** Touboul, F.; Ben Djedidia, M.; Acker, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 12p. (CONF-880962—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756425/JAW.

From 6. international conference on pressure vessel technology; Beijing, China (11 Sep 1988).

This paper presents an appraisement of design rules for bends under primary moments. For the study, we interpreted over 70 experimental results, half of which concerning closure bend tests. Founded on the limit analysis carried out by Spence and Findlay and on analysis of experimental tests performed on pipe-bends at CEA DEMT from 1974, we propose new formulations for B/sub 2/ indices and the use of ASME allowable stresses available for components designed by limit analysis in order to design piping elbows. We find that the rules for level D loadings offered by current design codes are unsafe for low pressurized austenitic elbows and over conservative for pressurized elbows. The ASME alternative procedures given by CCN 319 are accurated only for typical PWR piping in operating conditions.

14672 **(CEA-CONF—9656) Investigations of an advanced reactor with Pu fuel controlled without soluble boron.** Bergeron, J.; Lenain, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 9p. (CONF-8809229—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756428/JAW.

From A.N.S. International reactor physics conference; Jackson-Hole, USA (18 Sep 1988).

This paper presents the neutronic investigations of a pressurized water reactor with spectral shift. The fuel is plutonium. The moderation ratio can vary from 1.45 to 1.15. The reactor is controlled and monitored by means of gadoliniated spectral shift rod clusters and by B4C control rod clusters enriched with boron 10. A sufficient Gd/sub 2/O/sub 3/ content (6%) has been determined. The fissile material balance of the cycle is compiled by identifying the gains of the spectral shift: 14% of cycle time. The presence of an absorber in the spectral shift clusters is necessary to guarantee the subcriticality of the core in warm conditions (180/sup 0/C).

14673 **(EPRI-NP—6177) Feature-based imaging for cast stainless steel components: 1987 and 1988 field examinations: Final report.** Shanker, R.; Jeong, P.; Williams, R. (Electric Power Research Inst., Palo Alto, CA (USA); EPRI Nondestructive Evaluation Center, Charlotte, NC (USA)). Jan 1989. 86p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006678/JAW.

Digital-based inspection systems were used for the ultrasonic examinations and analysis of the hot-leg elbow in the Trojan Nuclear Power Plant in 1987 and 1988. This was the first time advanced systems were utilized during successive plant outages to monitor inspection data. The hot-leg elbow is made of statically cast stainless steel known for its mechanical strength and corrosion resistance. However, it presents unique difficulties in ultrasonic inspection because the large grain sizes can cause severe signal attenuation and beam redirection. The 1987 examination was authorized by Portland General Electric of Portland, Oregon, based on a study in 1985 which revealed that the hot-leg elbow could have experienced maximum strain and loading conditions because of steam generator snubber lockup. Seven indications were discovered during this examination; none of them was larger than the expected grain size in this material. The data were digitally processed at the EPRI NDE Center utilizing a personal computer based system that was integrated to other commercial systems and capable of feature-based imaging. Bandpass filtering and spatial averaging were found to increase signal-to-noise-ratio by as much as a factor of 2, i.e., 6 decibels. The hot-leg elbow was reexamined in 1988 using similar apparatus and inspection procedures. In addition to the seven 1987 indications, three more indications were discovered. These were determined to be in the midwall region. The largest of all the indications as reported by the inspection vendor was comparable to the average grain size, approximately 0.50 inch. The data were digitally processed at the EPRI NDE Center using similar techniques. Feature-based imaging of 1987 and 1988 inspection data made it possible to evaluate elbow conditions more reliably. 15 refs., 52 figs., 2 tabs.

14674 **(IAEA-R—4222-F) Power distribution unfolding on the basis of in-core rhodium powered detector readings. Final report for the period 1 November 1985 - 31 January 1988.** Andrzejewski, K. (Institute of Atomic Energy, Otwock-Swierk (Poland)). (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 78p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705330/JAW.

The task of unfolding of core power distribution for WWER reactors consists of processing of Self Powered Neutron Detector measurements to obtain estimated values for the uninstrumented assemblies. The method described in the report relies on 3-D power distributions calculated with BIPR-5 code and adjusted to instrumented assemblies to reproduce SPND measurements. The multiplicative modifying function is used for this purpose. Earlier a simple method was proposed and evaluated, in which measured power densities served as internal boundary conditions in the BIPR-5 calculations of the 3-D distributions for the entire core. Both methods have been tested using data from Loviisa-1 reactor core, consisting of 349 hexagonal fuel assemblies, each 14.7 cm across and 250 cm in length (active length). The SPNDs were placed on 4 levels: 50, 100, 150, 200 cm above the bottom of reactor core in 36 instrumented assemblies. Refs, figs and tabs.

14675 (IAEA-TC—560.02, pp 72-78) **Comparison of post-test calculations using TRAC-PF1 with the PMK-NVH experimental results.** Doval, A.S.; Ferreri, J.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

This report summarizes the criteria adopted to perform the post-test calculations for the PMK-NVH Standard Problem Test, sponsored by the IAEA. The nodalization corresponding to the TRAC-PF1 code runs is shown, the correlations adopted are specified, a comparison of the experimental and simulated conditions is given and, finally, the graphs of the time evolution of the thermohydraulic parameters corresponding to the specified table of initiating events are shown, as well as the comparison of predicted and experimental major events. A discussion of results is provided to consider some differences between the calculated and the experimental results. The results obtained with the TRAC-PF1 code show good agreement versus the experimental ones. (author). 1 ref., 11 figs, 3 tabs.

14676 **(IAEA-TECDOC—477) Simulation of a loss of coolant accident with hydroaccumulator injection. Results of the second standard problem exercise on the simulation of loss of coolant accidents.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 288p. NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88705461/JAW.

An essential component of nuclear safety activities is the analysis of postulated accidents which are taken as a design basis for a facility. This analysis is usually carried out by using complex computer codes to simulate the behaviour of the plant and to calculate vital plant parameters, which are then compared with the design limits. Since these simulations cannot be verified at the plant itself, computer codes must be validated by comparing the results of calculations with experimental data obtained in test facilities. The IAEA, having identified the need for experimental data due to the difficulties of building integral test facilities and the high costs of these experiments, has accepted the offer of the Hungarian Academy of Sciences and organized two standard problem exercises. In these exercises, experimental data from the simulation of a 7.4% break loss of coolant accident was compared with analytical predic-

tion of the behaviour of the facility calculated with computer codes. The second standard problem exercise involved a similar test, with the exception that in this case hydroaccumulator of the safety injection system were allowed to inject water in the system as anticipated in the design of the plant. This document presents a complete overview of the Second Standard Problem Exercise, including description of the facility, the experiment, the codes and models used by the participants and a detailed intercomparison of calculated and experimental results. It is recognized that code assessment is a long process which involves many inter-related steps, therefore, no general conclusion on optimum code or best model was reached. However, the exercise was recognized as an important contributor to code validation. 22 refs, figs and tabs.

14677 **(IAEA-TECDOC—479) Status of advanced technology and design for water cooled reactors: Light water reactors.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 190p. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88705463/JAW.

Water reactors represent a high level of performance and safety. They are mature technology and they will undoubtedly continue to be the main stream of nuclear power. There are substantial technological development programmes in Member States for further improving the technology and for the development of new concepts in water reactors. Therefore the establishment of an international forum for the exchange of information and stimulation of international co-operation in this field has emerged. In 1987 the IAEA established the International Working Group on Advanced Technologies for Water-Cooled Reactors (IWGATWR). Within the framework of IWGATWR the IAEA Technical Report on Status of Advanced Technology and Design for Water Cooled Reactors, Part I: Light Water Reactors and Part II: Heavy Water Reactors has been undertaken to document the major current activities and different trends of technological improvements and developments for future water reactors. Part I of the report dealing with LWRs has now been prepared and is based mainly on submissions from Member States. It is hoped that this part of the report, containing the status of advanced light water reactor design and technology of the year 1987 and early 1988 will be useful for disseminating information to Agency Member States and for stimulating international cooperation in this subject area. 93 refs, figs and tabs.

14678 (INIS-SU—64, pp 21-24) **Evaluation of isotope composition of uranium-thorium fuel irradiated in the WWER reactors.** Zaritskaya, T.S.; Matveev, L.V.; Rogozhkin, V.Yu.; Rudik, A.P.; Tsenter, Eh.M. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The paper is aimed at evaluation of changes in uranium-thorium fuel nuclide composition in the process of its irradiation in the WWER-440 reactor and at determination of reactor power characteristics with different initial thorium loads. Much attention is paid to nuclides effecting the radiation situation in the external fuel cycle. The calculations were carried out using the TOK program with constant power level. Five cases differing in the quantity of thorium fuel loaded in the reactor, that constitutes 0.1-0.5 of the total load are considered. /sup 235/U initial content in the fuel is determined subject to the condition that uranium-thorium fuel multiplication factor must be the same as for a standard WWER-440 reactor with uranium fuel. It is shown that /sup 232/ U content in irradiated thorium fuel elements is a tenth of a percent. Therefore the regenerated uranium reinsertion is possible under conditions of the fuel production automation. It is concluded that /sup 233/U, / sup 232/U and /sup 228/Th quantities relative to a unit of loaded thorium at similar average burnup and generated power don't depend on the quantity of thorium loaded in the reactor. 9 refs.; 9 tabs.

14679 (INIS-SU—64, pp 69-73) **Results of studying the WWER-1000 reactor core reactivity coefficients.** Astakhov, S.A.; Dukhovenskij, A.S.; Krajnov, Yu.A.; Kosourov, K.B.; Andrianov, G.Ya.; Nasedkin, A.Yu. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

Results of studying the WWER-1000 reactor core reactivity coefficients necessary for the safety analysis are presented. In the course of experiments made during the Novo-Voronezh-5 reactor start-up the dependence of the temperature reactivity coefficient value on the reactor core mean temperature, the value of reactivity pressure coefficient and the efficiency of boric acid are determined. Analysis of the obtained data permittes to conclude that the calculational procedures used for designing the commercial WWER-1000 reactor (BIPRUS, ROR, KR programs) on the whole give a correct description of the reactor core reactivity coefficients in different states. 10 refs.; 6 figs.; 2 tabs.

14680 (INIS-SU—64, pp 74-77) **On the neutron spatial distribution in ionization chamber channels of the WWER type reactors.** Berezovets, A.M.; Borodkin, G.I.; Borodkin, Eh.B.; Eremin, A.N.; Lomakin, S.S.; Moryakov, A.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

Results of experimental and calculational studies permitting to estimate the neutron flux spatial distribution in ionization chamber channels of the commercial WWER-1000 and WWER-440 reactors and also of the WWER-440 reactor with water biological shield are presented. The integral neutron flux density distribution along the channel cross section approximately at height of the core middle and the corresponding thermal and fast neutron flux density distributions are measured by the activation detectors. It is shown that the difference in fast neutron flux density exceeds that of thermal neutrons. The commercial WWER-1000 type reactor the fast neutron flux density is decreased by the factor of 1.7, and thermal neutron flux density - by the factor of 1.2, for the commercial WWER-440 reactor these values are 1.37 and 1.18, and for the WWER-440 one with water shield - 1.5 and 1.18. 6 refs.; 1 fig.; 3 tabs.

14681 (INIS-SU—64, pp 54-55) **Abstracts of the KSENIYa and KSENIYa-1 programs.** Semenov, V.N.; Tolmacheva, L.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The KSENIYa (FORTRAN-CERN, BESM-6 computer and FORTRAN-4, ES-1055 computer) and KSENIYa-1 (FORTRAN-CERN, BESM-6 computer) programs for calculation of xenon oscillations in the WWER type reactor and determining their optimum quenching are described. The neutron-physical problem for axial power distribution is solved in one-group approximation. Quenching of axial xenon oscillations is realized by variation of control rod position by height. Different optimum modes of the control rod displacement (relay and continuous) are defined. 5 refs.

14682 **(KFKI—1988-47/G) Analysis of consequences of steam generator collector rupture. Plant analysis with the RELAP4/MOD6 code based on PMK-NVH test results.** Ezsoel, Gy.; Perneczky, L.; Szabados, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Sep 1988. 32p. (In Hungarian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705573/JAW.

Results of calculations by use of RELAP4/MOD6 code are given for the SBLOCA on the steam generator collector rupture. The input data and sequence of events are the results of the corresponding PMK-NVH test. (author) 21 figs.

14683 **(NUREG—1334) Technical specifications, South Texas Project, Unit Nos. 1 and 2 (Docket Nos. 50-498 and 50-499): Appendix "A" to License Nos. NPF-76 and NPF-78.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jan 1989. 444p. NTIS, PC A19/MF A01 - GPO - OSTI. Order Number TI89005988/JAW.

The South Texas Project, Unit Nos. 1 and 2, Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

14684 **(EPRI-NP—4574-CCM-Pt.2,CH.5-Vol.3) ARMP-02 documentation: Part 2, Chapter 5, EPRI-PRESS computer code manual: Volume 3, Programmer's manual.** Poetschat, G.R.; Vossahlik, J.E.; Roark, R.L.; Hatteberg, R.L.; Mosteller, R.D. (Electric Power Research Inst., Palo Alto, CA (USA); GRP Consulting, Beaverton, OR (USA); Levy (S.), Inc., Campbell, CA (USA)). Jan 1989. 388p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006851/JAW.

EPRI-PRESS is a computer program that automates the ARMP PWR calculational path and file structure so as to generate a data base for nodal, static, and transient calculations. The CELL-2, NUPUNCHER-2, APLB, GAD, and PDQ7E V2 modules, which previously functioned as stand-alone codes, are combined into a single application which generates cross sections and other data for use in a variety of nodal simulator codes; SIMULATE-E, NODE-P2, and ARROTTA. In addition, the cross sections so generated can be input to stand-alone PDQ7E calculations. Based on internal procedures, the CELL-2 module generates cross sections and other data for normal fuel pins, non-fuel regions, lumped burnable boron poison rods, and gadolinia-fuel pins. "Generic" control-rod cross sections for a variety of PWR assembly designs are stored internally and can be used if the user so chooses. The NUPUNCHER-2, APLB, and GAD modules process the data from CELL-2 into input for the PDQ7E V2 module, performing transport-to-diffusion parameterizations where necessary. EPRI-PRESS contains case lists for so-called "one-temperature," "two-temperature," and "three-temperature" models, and it will execute cases for whichever one of these models the user specifies. EPRI-PRESS builds input, executes all the specified cases, manages all data files, and produces a binary integral file which can be processed by the NORGE-P linkage code into input for either SIMULATE-E or NODE-P2. By doing so, it dramatically reduces the amount of effort and time required to perform these functions. It also simplifies traceability through the reduction of input and the use of automated data management. 15 refs., 12 figs., 46 tabs.

14685 **(EPRI-NP—4574-CCM-Pt.2-Ch.5-Vol.2) ARMP-02 documentation: Part 2, Chapter 5: EPRI-PRESS computer code manual: Volume 2, User's manual.** Poetschat, G.R.; Vossahlik, J.E.; Roark, R.L.; Hatteberg, R.L.; Mosteller. (Electric Power Research Inst., Palo Alto, CA (USA); GRP Consulting, Beaverton, OR (USA); Levy (S.), Inc., Campbell, CA (USA)). Jan 1989. 592p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89007017/JAW.

EPRI-PRESS is a computer program that automates the ARMP PWR calculational path file structure so as to generate a data base for nodal, static, and transient calculations. The CELL-2, NUPUNCHER-2, APLB, GAD, and PDQ7E V2 modules, which previously functioned as stand-alone codes are combined into a single application which generates cross sections and other data for use in a variety of nodal simulator codes; SIMULATE-E, NODE-P2, and ARROTTA. In addition, the cross sections so generated can be input to stand-alone PDQ7E calculations. Based on internal procedures, the CELL-2 module generates cross sections and other data for normal fuel pins, non-fuel regions, lumped burnable boron poison rods, and gadolinia-fuel pins. "Generic" control-rod cross sections for a variety of PWR assembly designs are stored internally and can be used if the user so chooses. The NUPUNCHER-2, APLB, and GAD modules process the data from CELL-2 into input for the PDQ7E V2 module, performing transport-to-diffusion parameterization where necessary. EPRI-PRESS contains case lists for so-called "one-temperature," "two-temperature," and "three-temperature" models, and it will execute cases for whichever one of these models the user specifies. EPRI-PRESS builds input, executes all the specified cases, manages all data files, and produces a binary integral file which can be processed by the NORGE-P linkage code into input for either SIMULATE-E or NODE-P2. By doing so, it dramatically reduces the amount of effort and time required to perform these functions. It also simplifies traceability through the reduction of input and the use of automated data management. 15 refs., 14 figs., 96 tabs.

14686 **(EPRI-NP—4574-CCM-Pt.2-Ch.5-Vol.5) ARMP-02 documentation: Part 2, Chapter 5, EPRI-PRESS computer code manual: Volume 5, Guidelines.** Poetschat, G.R. (Electric Power Research Inst., Palo Alto, CA (USA); GRP Consulting, Beaverton, OR (USA)). Jan 1989. 54p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006845/JAW.

EPRI-PRESS is a computer program that automates the ARMP PWR calculational path and file structure so as to generate a data base for nodal static and transient calculations. The CELL-2, NUPUNCHER-2, APLB, GAD, and PDQ7E V2 modules, which previously functioned as stand-alone codes, are combined into a single application which generates cross sections and other data for use in a variety of nodal simulator codes; SIMULATE-E, NODE-P2 and ARROTTA. In addition, the cross sections so generated can be input to stand-alone PDQ7E calculations. Based on internal procedures, the CELL-2 module generates cross sections and other data for normal fuel pins, non-fuel regions, lumped burnable boron poison rods, and gadolinia-fuel pins. "Generic" control-rod cross sections for a variety of PWR assembly designs are stored internally and can be used if the user so chooses. The NUPUNCHER-2, APLB, and GAD modules process the data from CELL-2 into input for the PDQ7E V2 module, performing transport-to-diffusion parameterizations where necessary. EPRI-PRESS contains case lists for so-called "one-temperature," "two-temperature," and "three-temperature" models, and it will execute cases for whichever one of these models the user specifies. EPRI-PRESS builds input, executes all the specified cases, manages all data files, and produces a binary integral file which can be processed by the NORGE-P linkage code into input for either SIMULATE-E or NODE-P2. By doing so, it dramatically reduces the amount of effort and time required to perform these functions. It also simplifies traceability through the reduction of input and the use of automated data management. 8 refs., 11 figs.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 14358, 14736, 14752, 14756, 14767, 14784, 14830

14687 (INIS-SU—64, pp 25-27) **Calculational studying the transient period during fuel cycle change in HTGR type reactor with spherical fuel elements.** Gol'tsev, A.O. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

One of the virtues of HTGR type reactors with spherical fuel elements operating according to once-through-than-out principle is adaptability of the fuel cycle. On the example of the VG-400 reactor the reactor core neutron-physical parameters during change to the U-Pu fuel cycle are studied. The calculations are carried out with respect to the START program simulating in one-dimensional geometry the fuel recharging with discrete change in reactor core characteristics by height. The recharging periods are determined by an iterative method proceeding from the criticality conditions. The neutron transport is described in two-group diffusion approximation. It is shown that a system of inserting control rods is efficient only in the case when in transient period the rods are inserted in a pebble bed for a long period. Use of burnable poison (/sup 10/B) in transient period permits to reach 2 times decrease of maximum

energy release, and maximum fuel temperature drop by 100 deg C. A conclusion is drawn that the most efficient in transient period is the use of fuel elements with intermediate neutron-physical properties. This permits to decrease the maximum energy release by 1.5 times and maximum fuel temperature by 300 deg C. 4 refs.; 3 figs.

14688 (IWGGCR—16, pp 41) **Gas-graphite reactors in France, 1985-1986.** Bastien, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

France now operates 4 gas graphite reactors, after the decommissioning of the Chinon A2 reactor in June 1985 and the Monts d'Arree in July 1985. The problems encountered during the operation of Chinon A3, St-Laurent-des Eaux (two units) and Bugey 1 reactors are briefly discussed.

14689 (IWGGCR—16, pp 44-45) **Status of work on gas-cooled reactors in the USSR.** Grebennik, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

The report presents the status of work on the following concepts for HTGRs: the modular VTR-265 reactor with integrated arrangement of the primary equipment in a single prestressed vessel; the modular VTR-250 reactor with the core and heat exchanging equipment accommodated in separate vessels. The pilot energotechnological installation VG-400 is intended for co-generation of heat, steam and electricity for large power-consuming industries. 5 refs.

14690 (IWGGCR—16, pp 46) **UK gas-cooled reactor programme. Outline of progress over the past two years.** Askew, J.R. (UKAEA Northern Research Labs., Risley (UK)). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

There are now 26 Magnox reactors and 10 reactors of the first 5 Advanced Gas-Cooled Reactor stations in operation in the UK. Two further AGR stations have been built at Heysham II and Torness to an improved design based on the Hinkley/Hunterston stations. Some problems concerning the fuel designs are presented.

14691 **(IWGGCR—16) Seventh meeting of the International Working Group on Gas-Cooled Reactors, Beckum, Federal Republic of Germany, 29-30 October 1987. Summary report.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors). Jun 1988. 47p. (CONF-8710436—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW.

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

The document contains a summary report on the seventh meeting of the International Working Group on Gas-Cooled Reactors and 8 reports describing the national GCR programmes of Austria, China, France, Japan, Switzerland, USSR, UK and Commission of European Communities. A separate abstract was prepared for each of these reports. Refs and tabs.

14692 (IWGGCR—16, pp 35-37) **HTR research and development in Austria - 1986-1987 progress report.** Proksch, E.; Neumann, W.; Fritz, K. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

Though Austria has no national programme in the field of GCR's due to Austria's participation in the former OECD Dragon Project, a considerable amount of R and D work has been performed and is still going on in the following areas related to high-temperature gas cooled reactors (HTGR): high-temperature reactor fuel, high-temperature structural materials and high-temperature helium testing/prestressed concrete pressure vessel. The report summarizes the work performed since the 6th IWGGCR Meeting in Hamm, 1985. 8 refs.

14693 (IWGGCR—16, pp 38-40) **HTGR technology and its industrial applications in INET, China.** Lu Yingzhong; Wang Dazhong; Zhong Daxin; Gao Zuying; Qing Zenya. (Tsinghua Univ., Beijing (China). Inst. of Nuclear Energy Technology (INET)). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

Several design HTGR studies have been performed in the Institute of Nuclear Energy Technology (China). In the first phase a 100 MWt HTGR thorium thermal breeder and a HTGR core with thorium pebble-bed was designed. In the second phase a project on application of HTGR's for nuclear process steam production for heavy oil recovery and chemical industry has been initiated. The selected HTGR design for this project is the modular type pebble-bed reactor with the power of 200-500 MWt. The experiment and developmental work carried out in China on HTGR's since 1973 are summarized in this report. 7 refs, 4 tabs.

14694 (IWGGCR—16, pp 43-44) **Status of development of gas-cooled reactors in Switzerland, 1987.** Helbling, W.; Sarlos, G. (Schweizerische Interessengemeinschaft zur Wahrnehmung Gemeinsamer Interessen an der Entwicklung Nuklearer Technologien (IGNT), Wuerenlingen). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

Swiss industrial companies and the Federal Institute for Reactor Research are involved in the framework of German-Swiss cooperation in the HTR-500 project. Another effort in Switzerland is directed to the development of a small heating reactor, in the power range of 10 to 50 MW, for district heating, one of the concepts investigated being an HTR pebble-bed reactor.

14695 (IWGGCR—16, pp 47) **CEC activities on gas-cooled reactors.** Vivante, C. (Commission of the European Communities, Brussels (Belgium)). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

14696 **(IWGGCR—17) Gas-cooled reactor coolant circulator and blower technology. Proceedings of a specialists meeting held in San Diego 30 November - 2 December 1987.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors). Aug 1988. 164p. (CONF-8711106—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW.

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

In the previous 17 meetings held within the framework of the International Working Group on Gas-Cooled Reactors, a wide variety of topics and components have been addressed, but the San Diego meeting represented the first time that a group of specialists had been convened to discuss circulator and blower related technology. A total of 20 specialists from 6 countries attended the meeting in which 15 technical papers were presented in 5 sessions: circulator operating experience I and II (6 papers); circulator design considerations I and II (6 papers); bearing technology (3 papers). A separate abstract was prepared for each of these papers. Refs, figs and tabs.

14697 (IWGGCR—17, pp 23-30) **Two decades of excellent AGR circulator operating performance at AVR Juelich.** Ziermann, E.L.; Engel, J. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Juelich (Germany, F.R.); Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

During the twenty years' operation period there were only a few events connected with circulator operation, which were of interest. In 1970 the frequency convertor was modernized: The mercury-vapor rectifier was replaced by thyristors. In 1974 the helium core outlet temperature was increased from 850 to 950 deg. C. In 1977 after 72,000 operating hours a leak of about 3 mm/sup 2/ occurred in a superheater pipe in the steam generator. As a consequence 27 t of water penetrated into the primary system. Also the circulators were flooded to half their height. After drying and final revision of the reactor and its auxiliary systems, due to negligence one of the cooling water seals in the oil system had not been properly tightened. Thus there was a water ingress into the bearing oil followed by a temperature rise in one circulator bearing. Consequential damage was prevented by immediate shutdown. Disassembly of the circulator and replacement of the bearings supplied valuable information about the handling of contaminated circulator parts. Incidentally, it was stated when the bearing had been disassembled that the state of the bearing would probably have permitted further operation without exchange. In 1980 the AVR was adapted to the new safety requirements. The helium circulators including the oil systems and the electrical systems were not involved in this process. In the report about general operating experience the operating parameters are discussed in detail. An outlook is given on the further operating mode of the plant. Based on a record of 115,000 operating hours of the circulators, it can be said even today that a service-free operation of the circulators in gas-cooled reactors will be possible for several decades. 5 refs, 10 figs.

14698 (IWGGCR—17, pp 31-38) **Fort St. Vrain circulator operating experience.** Brey, H.L. (Public Service Co. of Colorado, Denver (USA)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

Fort St. Vrain, on the system of Public Service Company of Colorado, is the only high-temperature gas-cooled power reactor in the United States. Four helium circulators are utilized in this plant to transfer heat from the reactor to the steam generators. These unique machines have a single stage axial flow helium compressor driven by a single stage steam turbine. A single stage water driven (pelton wheel) turbine is the back-up drive utilizing either feed water, condensate, or fire water as the driving fluid. Developmental testing of the circulators was accomplished prior to installation into Fort St. Vrain. A combined machine operating history of approximately 250,000 hours has shown these machines to be of conservative design and proven mechanical integrity. However, many problems have been encountered in operating the complex auxiliaries which are necessary for successful circulator and plant operation. It has been 15 years since initial installation of the circulators occurred at Fort St. Vrain. During this time, a number of significant issues had to be resolved dealing specifically with machine performance. These events include cavitation damage of the pelton wheels during the initial plant hot functional testing, cracks in the water turbine buckets and cervic coupling, static shutdown seal bellows failure, and, most recently, degradation of components within the steam drive assembly. Unreliable operation particularly with the circulator auxiliaries has been a focus of attention by Public Service Company of Colorado. Actions to replace or significantly modify the existing circulators and their auxiliaries are currently awaiting decisions concerning the long-term future of the Fort St. Vrain plant. (author). 10 refs, 7 figs, 2 tabs.

14699 (IWGGCR—17, pp 39-47) **Circulator performance during THTR trial and post-commissioning operation.** Glahe, E.; Stoelzl, D. (Hochtemperatur-Kernkraftwerk G.m.b.H. (HKG), Hamm (Germany, F.R.); Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

Since the first trial runs the circulators have scored more than two years of trouble-free operation during the trial operation and commissioning phases. At no time the circulators gave reason for plant shutdown. The circulators which had been ordered in 1972 were delivered already ten years ago. Only two out of the six circulators were tested on a test stand in the workshop. In 1987 another identical standby circulator was supplied in support of an initiative to increase the basic conditions of plant availability. In view of the excellent result of the test period it can be assumed that the standby circulator will never be required. The 6 circulators equipped with oil bearings are each provided with a separate oil system whose pressure corresponds to that of the primary system. Safety aspects resulting from licensing requirements led to extensive efforts regarding the oil systems. These efforts involve also that part of the buffer helium flow which is released from the circulators with the oil draining from the bearings. During the commissioning phase it has been verified that the internal barrier helium system of the circulators is capable to retain the lubrication oil inventory within the circulator range, even if the external make-up barrier helium supply from the helium purification system is shut off. Thus it is ensured that leakage of oil into the primary helium system is ruled out by the shaft seal system. Further development work on the circulators is currently being continued for the only reason that active magnetic bearings permit vertical arrangement of the circulators with the impeller at the lower end without requiring the operation of an extremely complicated and expensive oil system. Apart from that, the experience gained with the THTR operation did not result in any changes in the design characteristics which had already been used in the AVR circulators. 7 refs, 13 figs.

14700 (IWGGCR—17, pp 47-53) **Development of CO/sub 2/ circulators.** Donaldson, J. (James Howden and Co. Ltd, Renfrew (UK)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

The development of the basic machine types we have supplied has not been without problems. The Windscale AGR (the prototype AGR) was a small 1.2 MW vertically up circulator with an inlet temperature of 237 deg. C (459 deg. F). Oil leakage problems occurred and were cured in the works test facility and the machine went into service with no other problems. The Horizontal 5 MW machines for Hinkley/Hunterston were not so fortunate with vibration problems, interface corrosion problems (effecting the whole reactor) and material dimensional stability problems. Oil ingress problems did not show up in test work but were later reported from site. These reports were initially exagerated due to the measuring techniques which took the operators some time to resolve. In the vertical 5 MW machines for Hartlepool and Heysham 1 there are two interesting factors, firstly a spar failure and secondly shaft axial stability. Many of the problems were due to modifications at site or our inability to model all aspects of site installation from which lessons for the future can be learned. The latest stations Torness and Heysham II incorporate these lessons. The machines have been designed with so much margin that during the resolution of the reactor control rod gag problems the machines were run continuously at 20% overload (6.3 MW). From an initial accident case of 350 deg. C inlet temperature, this increased to 458 deg. C and now stands at 585 deg. C. No modifications to the impeller were required. The site experience to date is good with no operational problems reported. (author). 4 figs.

14701 (IWGGCR—17, pp 53-59) **Twenty-five years of Brown Boveri experience in development, design and fabrication of circulators for HTGR.** Stoelzl, D. (Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

The two circulators for the AVR experimental reactor in Juelich, Federal Republic of Germany, were supplied. The circulators, which are equipped with oil bearings, have been operating troublefree since the start of commissioning in 1966. As a consequence of a water ingress into the reactor resulting from a steam generator damage one bearing was replaced in 1977 after 72,000 operating hours. Up to the present date, each of the circulators has scored 115,000 hours of operation, one of them without any disassembly. In the THTR 300 in Schmehausen, Federal Republic of Germany, 6 BBC circulators are in operation. The insertable circulator units equipped with oil bearings have successfully proven their operating capability without any problems during the commissioning phase and the 100% power operation which was started recently. Currently active magnetic bearings are being developed for advanced gas-cooled reactors such as the HTR 100, the HTR 500 and the heating reactor after excellent results have been furnished by a small prototype in a test loop. This ADI circulator has since scored more than 15,000 operating hours without any trouble. A retainer bearing test stand also equipped with active magnetic bearings has been in operation for nearly 2 years. This test stand serves for developing the conditions for safe rundown of the rotors of even the largest circulators after the magnetic bearings have been deenergized unintentionally. Development work is conducted on the prototype of a safety-relevant circulator held in magnetic bearings, to be used for decay heat removal in the HTR 500. The original aim to have circulators without auxiliary medium for bearing lubrication will thus be reached. The advantages to be obtained in process and systems design are a supplementary support to the inherent safety characteristics of high-temperature reactors. Another advantage of these bearings is cost reduction. 5 refs, 7 figs.

14702 (IWGGCR—17, pp 69-76) **Considerations on the design of a helium circulator for a high temperature modular reactor system.** Dumm, K.; Donaldson, J. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.); James Howden and Co. Ltd, Renfrew (UK)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

A modular helium cooled, high temperature reactor system with a thermal output of 200 MW per reactor has been developed by the KWU group for cogeneration of electricity and process steam. The flow of the reactor coolant - Helium at 60 bars and 250/700 deg. C is maintained by one circulator per reactor. The circulator is driven by a variable speed Siemens asynchronous motor and is submerged in the helium primary system. For operational reasons high reliability and availability of the circulator is required. The operational requirements for the circulator design are presented in this paper. The actual design has been carried out in close cooperation with the designer and manufacturer of all submerged circulators operating in AGR plants in Great Britain, James Howden Co. Renfrew, Scotland. Design solutions received so far and mainly based on sufficiently proven components - such as oil bath lubricated bearing systems - will be described. Special attention will be paid on the necessary test work; especially for the prototype to confirm the lay out. (author). 9 figs.

14703 (IWGGCR—17, pp 77-82) **Main circulator design features for HTR 100, HTR 500 and space heating plants.** Engel, J.; Glass, D. (Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

All design alternatives for modern high-temperature reactors have a common circulator concept: It is based on a vertical shaft design with a flying impeller. The circulators are equipped with active magnetic bearings and are driven by induction motors connected to variable-speed static converters. Due to their multiple functions during normal reactor operation and under accident conditions, extremely high requirements are made to safety-relevant circulators, since with the reactor pressurized as well as under depressurized conditions specified delivery heads and flow rates have to be ensured. The use of active magnetic bearings permits to obtain maintenance-free operation and functional safety to an extent which had not been achieved before. Magnetic bearings are therefore provided for the total range including primary gas circulators of a drive power of several MW as well as circulators for helium loops of reactor auxiliary systems. The essential feature for using active magnetic bearings is the retainer bearing technology, preventing contact between rotor and static circulator parts upon unintended deenergisation of the magnets. Results of current experiments are reported. Another aspect to be considered for reliable long-term operation for several decades is the effect of rotor dynamics. The various natural frequencies resulting from torsion and bending modes in view of a drive by a frequency-controlled induction motor have to be considered as well as the specific characteristics of the active magnetic bearings. Special attention has to be directed to the internal cooling loop so as to ensure that reactor temperature excursions in the event of deviation from normal operation can be overcome without damage. For circulator components exposed to temperature fields the design characteristics are determined by combining experimental and analytical methods. (Abstract Truncated)

14704 (IWGGCR—17, pp 83-93) **Systems engineering requirements impacting MHTGR circulator design.** Chi, H.W.; Baccaglini, G.M.; Potter, R.C.; Shenoy, A.S. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

At the initiation of the MHTGR program, an important task involved translating the plant users' requirements into design conditions. This was particularly true in the case of the heat transport and shutdown cooling systems since these embody many components. This paper addresses the two helium circulators in these systems. An integrated approach is being used in the development of design and design documentation for the MHTGR plant. It is an organized and systematic development of plant functions and requirements, determined by top-down design, performance, and cost trade-off studies and analyses, to define the overall plant systems, subsystems, components, and human actions. These studies, that led to the identification of the major design parameters for the two circulators, are discussed in this paper. This includes the performance information, steady state and transient data, and the various interface requirements. The design of the circulators used in the MHTGR is presented. (author). 1 ref., 17 figs.

14705 (IWGGCR—17, pp 93-115) **Helium circulator design concepts for the modular high temperature gas-cooled reactor (MHTGR) plant.** McDonald, C.F.; Nichols, M.K.; Kaufman, J.S. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

Two helium circulators are featured in the Modular High-Temperature Gas-Cooled Reactor (MHTGR) power plant - (1) the main circulator, which facilitates the transfer of reactor thermal energy to the steam generator, and (2) a small shutdown cooling circulator that enables rapid cooling of the reactor system to be realized. The 3170 kW(e) main circulator has an axial flow compressor, the impeller being very similar to the unit in the Fort St. Vrain (FSV) plant. The 164 kW(e) shutdown cooling circulator, the design of which is controlled by depressurized conditions, has a radial flow compressor. Both machines are vertically oriented, have submerged electric motor drives, and embody rotors that are supported on active magnetic bearings. As outlined in this paper, both machines have been conservatively designed based on established

practice. The circulators have features and characteristics that have evolved from actual plant operating experience. With a major goal of high reliability, emphasis has been placed on design simplicity, and both machines are readily accessible for inspection, repair, and replacement, if necessary. In this paper, conceptual design aspects of both machines are discussed, together with the significant technology bases. As appropriate for a plant that will see service well into the 21st century, new and emerging technologies have been factored into the design. Examples of this are the inclusion of active magnetic bearings, and an automated circulator condition monitoring system. (author). 18 refs, 20 figs, 13 tabs.

14706 (IWGGCR—17, pp 115-130) **Helium compressor aerodynamic design considerations for MHTGR circulators.** McDonald, C.F. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

Compressor aerodynamic design considerations for both the main and shutdown cooling circulators in the Modular High-Temperature Gas-Cooled Reactor (MHTGR) plant are addressed in this paper. A major selection topic relates to the impeller type (i.e., axial or radial flow), and the aerothermal studies leading to the selection of optimum parameters are discussed. For the conceptual designs of the main and shutdown cooling circulators, compressor blading geometries were established and helium gas flow paths defined. Both circulators are conservative by industrial standards in terms of aerodynamic and structural loading, and the blade tip speeds are particularly modest. Performance characteristics are presented, and the designs embody margin to ensure that pressure-rise growth potential can be accomodated should the circuit resistance possibly increase as the plant design advances. The axial flow impeller for the main circulator is very similar to the Fort St. Vrain (FSV) helium compressor which performs well. A significant technology base exists for the MHTGR plant circulators, and this is highlighted in the paper. (author). 15 refs, 16 figs, 12 tabs.

14707 (IWGGCR—17, pp 130-138) **Main gas circulator for VG-400 reactor plant.** Mitenkov, F.M.; Kostin, V.I.; Novinskij, E.G.; Kuropatov, A.I.; Protsenko, A.N.; Smirnov, V.P.; Stolyarevskij, A.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

Principle parameters and operating conditions of the main gas circulator (MGC) in VG-400 reactor plant are presented. Brief MGC design description and experimental work scope are given. (author). 4 refs, 4 figs, 1 tab.

14708 (IWGGCR—17, pp 141-148) **Recent research and development of bearings for helium circulator.** Taniguchi, S.; Ezaki, Z.; Kawaguchi, K.; Matsumura, N.; Kozima, M. (Mitsubishi Heavy Industries Ltd, Nagasaki (Japan)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

This paper mainly describes recent studies and successful applications of water lubricated bearing and gas lubricated bearing. Both types of bearing seem to be suitable for a turbo machine installed in an atomic energy plant - such as the helium circulator of a HTGR - not to be affected by radioactivity, so we have been attracted by them for about 10 years. The former was investigated theoretically taking account of turbulent flow due to the low viscosity of water, and compared with the experimental data. Good agreement was obtained, and a successful example applied to a small-sized high speed air compressor is shown. The latter was investigated using a large-sized bearing test rig simulated to an actual machine. The tilting pad journal bearing and the tilting pad thrust bearing were taken and improved for some aspects. These bearings have been taken into service on an actual circulator and are now operating successfully. Currently, a magnetic bearing is being studied to pay special attention to endurance for an earthquake and catcher bearing system. We would like to have an opportunity to present these results in the near future. (author). 5 refs, 15 figs, 2 tabs.

14709 (IWGGCR—17, pp 148-156) **Operating experience of gas bearing helium circulators in HTGR development facility.** Shimomura, H.; Kawaji, S.; Fujisaki, K.; Ihizuka, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

The large scale helium gas test facility (HENDEL) has been constructed and operated since March 1982 at the Japan Atomic Energy Research Institute to develop HTGR components. The five electric driven gas circulators with dynamic gas bearings are used to circulate the helium gas of 4MPa and 400 deg. C in loops for their compactness, gas tightness, easy maintenance and free from gas contamination. All of these circulators are variable speed types of 3,000 to 12,000 rpm and have the same gas bearings and electric motors. The four machines among them are equipped with centrifugal impeller and one other machine has regenerative type, and the weight of both type rotors are nearly the same. After the troubles and repairing, both type of circulators were tested and the vibration characteristics were measured as preventing maintenance. From the test and measurements of the circulators, it was presumed that the first trouble on regenerative type was caused from excess unbalance force by falling off of a small pin from the rotating part and the second severe trouble on it was caused by the whipping in gas bearing. The static load on tilting pads indicated close relations to occurrence of the whirling through the measurements. It is recognized that fine balancing of the rotors and delicate clearance adjustment of the bearings are very important for the rotor stability and that the mechanism should be designed and machined so precise as to be adjustable. As the gas bearing would be damaged in an instantaneously short time, the monitoring technique for it should be so fast and predictive as to prevent serious damage. Through the tests, the vibration spectrum monitoring method seems to be predictive and useful for early detection of the shaft instability. It will be concluded that the gas bearing machine is an excellent system in its design philosophy, however, it also needs highly precise machining and delicate maintenance technique. 4 refs, 10 figs, 1 tab.

14710 (IWGGCR—17, pp 156-163) **Gas erosion of impeller housing in the operation of a high-temperature, high-pressure helium circulator.** Sanders, J.P.; Heestand, R.L.; Young, H.C. (Oak Ridge National Lab., TN (USA)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

Three gas-bearing circulators are installed in series in a high-pressure, high-temperature loop to provide helium flow up to 0.47 m/sup 3//s at a total head of 78 kJ/kg. The design pressure is 10.7 MPa, and temperatures of 1000 deg. C can be obtained in the test section. The inlet temperature to the circulators is limited to 450 deg. C. The 200-kW motor for each circulator is enclosed in the pressure boundary, and the motor is cooled by circulating the gas within the cavity over a water-cooled coil. The full operating speed is 23,500 rpm. A full-flow filter, absolute for particulate above 10 μm, is installed upstream of the circulator to protect the gas bearing surfaces. The minimum clearances between these surfaces during operation are in the range of 15 to 30 μm. During a routine examination of the circulator, deep V-shaped grooves were found in the stationary surface of this cavity. At the same time, a very fine, dark particulate was observed in crevices of the housing. At first it was assumed that the grooves were formed by particulate erosion; however, examination of the grooves and discussions with persons experienced with large circulator operation changed this opinion. Erosion caused by particulate is characteristically rounded on the bottom and has a greater width to depth aspect than the V-shaped grooves, which were observed. Analysis of the particulate indicated that it was essentially the material of the housing that had undergone reactions with impurities in the circulating gas. It was

subsequently concluded that the impeller housing had not been heat treated in a sufficiently oxidizing atmosphere after machining to form an adherent oxide coating. This suboxide coating was eroded by the shear forces in the gas. The exposed layer of metal was then further oxidized by the impurities in the gas, and these layers of oxide were successively eroded to produce the grooves. (Abstract Truncated)

14711 (IWGGCR—17, pp 59-65) **Operating experience with gas-bearing circulators in a high-pressure helium loop.** Sanders, J.P.; Gat, U.; Young, H.C. (Oak Ridge National Lab., TN (USA). Engineering Technology Div.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88705385/JAW. (CONF-8711106—).

From Meeting on gas-cooled reactor coolant circulator and blower technology; San Diego, CA, USA (30 Nov 1987).

A high-pressure engineering test loop has been designed and constructed at the Oak Ridge National Laboratory for circulating helium through a test chamber at temperatures to 1,000 deg. C. The purpose of this loop is to determine the thermal and structural performance of proposed components for the primary loops of gas-cooled nuclear reactors. Three gas-bearing circulators, mounted in series, provide a maximum volumetric flow of 0.47 m/sup 3/s and a maximum head of 78 kJ/kg at operating pressures from 0.1 to 10.7 MPa. Control of gaseous impurities in the circulating gas was the significant operating requirement that dictated the choice of a circulator that is lubricated by the circulating gas. The motor for each circulator is contained within the pressure boundary, and it is cooled by circulating the gas in the motor cavity over water-cooled coils. Each motor is rated at 200 kW at a speed of 23,500 rpm. The circulators have been operated in the loop for more than 5,000 h. The flow of the gas in the loop is controlled by varying the speed of the circulators through the use of individual 250-kVA, solid state power supplies that can be continuously varied in frequency from 50 to 400 Hz. To prevent excessive wear on the gas bearings during startup, the circulator motor accelerates the rotor to 3,000 rpm in less than one second. During operation, no problems associated with the gas bearings, per se, were encountered; however, related problems pointed to design considerations that should be included in future applications of circulators of this type. The primary test that has been conducted in this loop required sustained operation for several weeks without interruption. After a number of unscheduled interruptions, the operating goals were attained. During part of this period, the loop was operated with only two circulators installed in the pressure vessels with a guard installed in the third vessel to protect the closure flange from the gas temperatures.

14712 **(Juel-Spez—414) Sliding friction characteristics of different pairs of materials at room temperature in a He atmosphere and in vacuum.** Fleischer, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie). Sep 1987. 108p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756811/JAW.

In the framework of testing a refueling canal valve for fuel transfer systems of high-temperature reactors, investigations were carried out on metal alloys, CVD hard material coatings (carbides, nitrides) and solid lubricants at room temperature. These investigations are to discover suitable material combinations for the inner and outer wedge pairs of the expanding mechanism subjected to heavy strain and to provide general information about the applicability of material combinations with helium and vacuum conditions. The tribological fundamentals were prepared and 19 material combinations were tested at room temperature in helium and partly in vacuum with regard to a durability of 75x10/sup 3/ dynamic loading cycles. The tests showed that under the conditions mentioned and for the selected arrangement - wedge mechanism - material combinations can be chosen the working life of which will exceed the required durability. (orig./IHOE).

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 14670, 14747, 14779, 14830

14713 **(CEA-CONF—9654) Calculation of control assembly effectiveness in a LMFBR by a transport-diffusion equivalence method.** Benoist, P.; Palmiotti, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Compagnie Internationale pour l'Informatique (CII), 75 - Paris (France)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 16p. (CONF-8809229—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756426/JAW.

From A.N.S. International reactor physics conference; Jackson-Hole, USA (18 Sep 1988).

A method allowing the calculation of the control assembly effectiveness in a fast neutron reactor is proposed. For each type of heterogeneous assembly - control or follower - a polar parameter, taking into account the assembly absorption and the axial leakage of neutrons inside the assembly, is defined; in a similar way a bipolar parameter, taking into account the reaction of the assembly to a transverse flux gradient, is also defined. These two parameters, deduced from transport theory, are used to determine the absorption cross-section and the diffusion coefficient of an equivalent homogeneous control or follower assembly. These new parameters are to be introduced in an one-group diffusion code calculating the reactor as a whole with any number of control and follower assemblies. An approximate generalization to multigroup theory is proposed. Numerical comparisons show that this equivalent diffusion method gives results which are much closer to transport results than those obtained by the classical diffusion theory.

14714 **(CONF-880772—2) Overview of the ANL advanced LMR system thermal-hydraulic test program supporting both GE/PRISM and RI/SAFR.** Oras, J.J.; Kuzay, T.M.; Kasza, K.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005802/JAW.

From 3. international symposium on refined flow modelling and turbulence measurements; Tokyo, Japan (26 Jul 1988).

Descriptions of the ANL thermal-hydraulic water models of both the PRISM and SAFR reactors are presented, together with results from Phases I and II of the thermal-hydraulic test program. Phenomena discovered during these tests and modeling results are presented. Overall, these efforts demonstrate the acceptable thermal-hydraulic performance of both the PRISM and SAFR concepts.

14715 **(CONF-880911—30) Techniques for computing reactivity changes caused by fuel axial expansion in LMR's.** Khalil, H. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005873/JAW.

From International reactor physics conference; Jackson Hole, WY, USA (18 Sep 1988).

An evaluation is made of the accuracy of methods used to compute reactivity changes caused by axial fuel relocation in fast reactors. Results are presented to demonstrate the validity of assumptions commonly made such as linearity of reactivity with fuel elongation, additivity of local reactivity contributions, and the adequacy of standard perturbation techniques. Accurate prediction of the reactivity loss caused by axial swelling of metallic fuel is shown to require proper representation of the burnup dependence of the expansion reactivity. Some accuracy limitations in the methods used in transient analyses, which are based on the use of fuel worth tables, are identified, and efficient ways to improve accuracy are described. Implementation of these corrections produced expansion reactivity estimates within 5% of higher-order method for a metal-fueled FFTF core representation. 18 refs., 3 figs., 3 tabs.

14716 **(CONF-880911—31) Shielding experiments in a liquid-metal-reactor critical assembly.** Brumbach, S.B.; Grasseschi, G.L.; Collins, P.J. (Argonne National Lab., Idaho Falls, ID (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005868/JAW.

From International reactor physics conference; Jackson Hole, WY, USA (18 Sep 1988).

Results are presented for experiments in ZPPR characterizing the neutron flux and neutron spectra through prototype LMR shields. Shield compositions were (by volume) 90% stainless steel/10% sodium and 39% natural B_4C/21% stainless steel/40% sodium. Measurements were made through core, blanket, reflector, shield and ex-core sodium pool regions with foils of ^{235}U, ^{238}U and indium and boron chambers. Proton recoil spectra were measured in the sodium pool. Core analysis methods (nodal transport, xy geometry, 21 energy groups) were used to calculate spectra and reaction rates. Agreement with measurement varied among regions, with C/E values for ^{235}U fission larger than unity in thick steel regions and with C/E for other reactions decreasing with radius through the shield and sodium pool. 6 refs., 6 figs., 4 tabs.

14717 **(CONF-880911—32) Critical experiment tests of bowing and expansion reactivity calculations for LMRS.** Schaefer, R.W. (Argonne National Lab., Idaho Falls, ID (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005865/JAW.

From International reactor physics conference; Jackson Hole, WY, USA (18 Sep 1988).

Experiments done in several LMR-type critical assemblies simulated core axial expansion, core radial expansion and bowing, coolant expansion, and control driveline expansion. For the most part new experimental techniques were developed to do these experiments. Calculations of the experiments basically used design-level methods, except when it was necessary to investigate complexities peculiar to the experiments. It was found that these feedback reactivities generally are overpredicted, but the predictions are within 30% of the experimental values. 14 refs., 2 figs., 4 tabs.

14718 **(DOE/OR—896) Materials and structures technology program plan for advanced reactors: Program plan, FY 1988--1993.** (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005954/JAW.

To satisfy the long-term needs of the United States for electric power, the strategy of the Department of Energy (DOE) includes development of advanced liquid metal reactor (LMR) plants as a low-cost, low-risk, nuclear power option. These plants will have passive safety features, such as self-actuated shutdown and natural-convection decay heat removal, and will employ modular construction techniques. Compared to current light-water reactor (LWR) plants, the advanced LMR plants offer benefits including (1) enhanced safety and licensability, (2) increased reliability and availability, (3) improved economics and (4) increased US competitiveness in the international marketplace. As part of the DOE Advanced LMR Program, conceptual design was completed for two plants, the Power Reactor Inherently Safe Module (PRISM) by the General Electric Company (GE), and the Sodium Advanced Fast Reactor (SAFR) by Rockwell International Corporation (RI). PRISM was selected as the reference concept, and advanced conceptual design GE is scheduled for FY 1989--91. Advanced LMR plants will be designed for a service life of up to 60 years. Such long service presents significant challenges to the structural integrity of the reactor and the heat transport systems. These challenges arise not only from the relatively high service temperatures but also from the large, rapid temperature changes associated with the use of a liquid metal as the heat transport medium. An effective response to this unique set of challenges is required to ensure the success of the DOE Advanced LMR Program. For this reason, the DOE Office of Technology Support Programs established a coordinated program to develop the specialized high-temperature materials and structural design technology necessary for safe and reliable, long-term operation of advanced LMR plants. This Program Plan describes the activities required to complete the development of this technology.

14719 (INIS-SU—64, pp 14-18) **Fast reactor parameter optimization taking into account changes in fuel charge type during reactor operation time.** Afrin, B.A.; Rechnov, A.V.; Usynin, G.B. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The formulation and solution of optimization problem for parameters determining the layout of the central part of sodium cooled power reactor taking into account possible changes in fuel charge type during reactor operation time are performed. The losses under change of fuel composition type for two reactor modifications providing for minimum doubling time for oxide and carbide fuels respectively, are estimated. 3 tabs.

14720 **(WHC-SA—0331) Fast flux test facility interim examination and maintenance cell fuel duct cutters: Remote operations design considerations.** Gibbons, P.W. (Westinghouse Hanford Co., Richland, WA (USA)). Nov 1988. Contract AC06-87RL10930. 9p. (CONF-890304—28). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004903/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

Two remotely operated milltype slitting cutters, specifically designed for remote, hot-cell use have been in service in the Fast Flux Test Facility (FFTF) Interim Examination and Maintenance (IEM) Cell for 3 and 4 yr, respectively without the benefit of hands-on maintenance. These cutters are used to sever the outer duct of Driver Fuel Assemblies (DFA) being dismantled for further examination elsewhere. During this period, twelve DFAs requiring duct cutting were dismantled in the IEM Cell. A discussion of the remote design features of those cutters is presented that highlights features that were successful and addresses areas that needed improvement. 3 refs., 7 figs.

14721 **A gauge for nondestructive assay of irradiated fuel rods.** Tessler, G.; Beaudoin, B.P.; Beggs, W.J.; Freeman, L.B.; Kahler, A.C.; Schick, W.C. Jr. (Westinghouse Electric Corp., Bettis Atomic Power Lab., P.O. Box 79, West Mifflin, PA (US));. *Nuclear Technology;* **82**: No. 3, 275-289(Sep 1988).

The light water breeder reactor (LWBR) was developed by the Bettis Atomic Power Laboratory under the technical direction of the Office of Naval Reactors, U.S. Department of Energy. The LWBR operated successfully in the Shippingport Atomic Power Station from 1977 to 1982, producing more than 29,000 equivalent full-power hours. Because of the small breeding gain (1.35%) predicted for this self-sustaining breeder, proof of breeding required accurate nondestructive assay of expended fuel from the LWBR. The fact that breeding has been proven in the LWBR means that this reactor provides a vast alternative energy resource using plentiful thorium fuel. A gauge, called the production irradiated fuel assay gauge (PIFAG), was developed to nondestructively assay whole irradiated fuel rods from the LWBR. The gauge uses the method of active interrogation with /sup 252/Cf source neutrons and delayed neutron counting. A description is given of the PIFAG, its calibration, and its application to the assay of irradiated LWBR fuel rods. A comparison of the PIFAG results with destructive assay results for 17 irradiated LWBR fuel rods show that the two methods are in excellent agreement, differing by 0.069 and 0.162% for the low- and high-energy PIFAG interrogation spectra, respectively.

14722 **Fracture toughness of irradiated stainless steel alloys.** Mills, W.J. (Westinghouse Electric Corp., Bettis Atomic Power Lab., P.O. Box 79, West Mifflin, PA (US));. *Nuclear Technology;* **82**: No. 3, 290-303(Sep 1988).

The postirradiation fracture toughness responses of Types 316 and 304 stainless steel wrought products, cast CF8 stainless steel, and Type 308 stainless steel weld deposit were characterized at 427°C using J/sub R/ curve techniques. Fast neutron irradiation of these alloys caused an order-of-magnitude reduction in J/sub c/ and two-orders-of-magnitude reduction in the tearing modulus at neutron exposures above 10 dpa, where radiation-induced losses in

toughness appeared to saturate. Saturation J/sub c/ values for the wrought materials ranged from 28 to 31 kJ/m/sup 2/; the weld exhibited a saturation level of 11 kJ/m/sup 2/. Maximum allowable flaw sizes for highly irradiated stainless steel components stressed to 90% of the unirradiated yield strength are on the order of 3 cm for the wrought material and 1 cm for the weld. Austenitic stainless steel alloys are used extensively as structural materials in liquid-metal fast breeder reactors (LMFBRs).

14723 **Calculational methods comparisons for liquid metal reactor shields.** Carter, L.L.; Morford, R.J.; Mann, F.M. (Westinghouse Hanford Co., Richland, WA (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A one-dimensional comparison is made between Monte Carlo (MCNP), discrete ordinates (ANISN), and diffusion theory (MIDX) calculations of neutron flux and radiation damage from the core of the Fast Flux Test Facility (FFTF) out to the reactor vessel. Diffusion theory was found to be reasonably accurate for the calculation of both total flux and radiation damage. However, for large distances from the core, the calculated flux at very high energies is low by an order of magnitude or more when diffusion theory is used. Particular emphasis was placed in this study on the generation of multitable cross sections for use in discrete ordinates codes that are self-shielded, consistent with the self-shielding employed in the generation of cross sections for use with diffusion theory. The Monte Carlo calculation, with a pointwise representation of the cross sections, was used as the benchmark for determining the limitations of the other two calculational methods.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 14747

14724 **(N—89-12665) SP-100 nuclear space power systems with application to space commercialization.** Smith, J.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 17p. (NASA-TM—101403; E—4487; NAS—1.15:101403; CONF-890356—). NTIS, PC A03/MF A01.

From Space commercialization: roles of developing countries; Nashville, TN, USA (5 Mar 1989).

The purpose of this paper is to familiarize the Space Commercialization Community with the status and characteristics of the SP-100 space nuclear power system. The program is a joint undertaking by the Department of Defense, the Department of Energy and NASA. The goal of the program is to develop, validate, and demonstrate the technology for space nuclear power systems in the range of 10 to 1000 kWe electric for use in the future civilian and military space missions. Also discussed are mission applications which are enhanced and/or enabled by SP-100 technology and how this technology compares to that of more familiar solar power systems. The mission applications include earth orbiting platforms and lunar/Mars surface power.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 14433, 14463, 14464, 14810, 14811

14725 **(EPRI-NP—6179-M) Procedures for determining and monitoring simulator operating limits: Final report.** Pellechi, M.S.; Wolf, B.J.; Eichelberg, R.A. (Electric Power Research Inst., Palo Alto, CA (USA); General Physics Corp., Columbia, MD (USA)). Jan 1989. 22p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006672/JAW.

Establishing a means to avoid negative training on a nuclear power plant simulator involves both the determination and the implementation of simulator operating limits. Determination and implementation involves the evaluation of the simulated systems, the computer capabilities, and the individual training program. The EPRI plan described in this report details the procedures to determine and implement the simulator operating limits that could result in negative training, and to verify the compliance with applicable regulatory requirements. An estimate of the resources to conduct this plan is included as are the necessary forms to document performance. 5 refs.

14726 **(NUREG—0540-Vol.10-No.11) Title list of documents made publicly available, November 1--30, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). Jan 1989. 423p. NTIS, PC A18/MF A01 - GPO - OSTI. Order Number TI89006961/JAW.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

14727 **(NUREG—0750-Vol.28-No.5) Nuclear Regulatory Commission issuances, November 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). 1988. 68p. NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89005991/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

14728 **(NUREG—0936-Vol.7-No.4) NRC Regulatory Agenda: Quarterly report, October--December 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). Jan 1989. 92p. OSTI. Order Number TI89006831/JAW.

The NRC Regulatory Agenda is a compilation of all rules which the NRC has proposed or is considering action on, and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission.

14729 **(NUREG/CR—2000-Vol.7-No.11) Licensee Event Report (LER) compilation for month of November 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA)). Dec 1988. Contract AC05-84OR21400. 96p. (ORNL/NSIC—200-Vol.7-No.11). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89005926/JAW.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983.

NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

14730 **(ORNL/TM—9402) Validation of the SCALE code system and two cross-section libraries for plutonium benchmark experiments.** Easter, M.E.; Primm, R.T. III. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 53p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005892/JAW.

The calculation and analysis of 31 critical plutonium experiments are presented. Two control modules, used with two cross-section libraries available in the standardized computer analyses for licensing evaluation (SCALE) system, are employed in the analysis. The results obtained are discussed in detail and are analyzed for trends and biases. The comparison results with experimental validates the cross-section libraries and reduces the degree of conservatism that would otherwise have to be applied to the results of future using the two cross-section libraries and two control modules in the SCALE system. It appears that 27-group cross sections derived from the evaluated nuclear data file–version IV provide better agreement between calculation and experiment than the 16 group library originally developed by Hansen and Roach. 10 refs., 16 figs., 4 tabs.

2108 Economics

REFER ALSO TO CITATION(S) 14678, 14687, 14811

22 NUCLEAR REACTOR TECHNOLOGY

14731 **(INIS-SU—64) Nuclear reactor physics and engineering. Scientific-technical collection.** (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 87p. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhkniki.; No. 8.

Selected papers have been processed separately for inclusion in the Energy Data Base. (MHR)

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 14686, 14715, 14730

14732 **(CEA-CONF—9657) Nuclear data qualification for thermal neutron reactors.** Tellier, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 13p. (CONF-8809229—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756429/JAW.

From A.N.S. International reactor physics conference; Jackson-Hole, USA (18 Sep 1988).

Generally the thermal neutron reactors are computed in a multigroup approximation and the nuclear data must be first processed to obtain multigroup cross sections. We must carefully check these multigroup libraries, to avoid the introduction of too much approximations with the processing codes which are used (modified NJOY or similar French codes). In the French Atomic Energy Commission the thermal neutron reactors calculations are performed which the APOLLO code which solves the Boltzmann equations by the collision probability method with ninety nine groups. Obviously it is not possible to obtain tendencies for all the cross sections and all the groups because the number of unknown quantities is too large. But we can choose a small number of synthetic parameters which represent the general trend of the cross sections versus energy. For the most part, it is sufficient for reactor physics. We have used the tendency research method to validate the nuclear data of the major actinides: Uranium 235 and 238, Plutonium 239 and 240. Up to now, the thermal reactors are not sensitive enough to Plutonium 241 and 242 to obtain accurate tendencies for all the cross sections of these isotopes. Nevertheless, the irradiated fuel analysis give us some informations about their capture cross sections.

14733 **(CEA-CONF—9658) Low energy uranium 235 nuclear data updating and qualification.** Tellier, H.; Vanuxeem, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 9p. (CONF-8809229—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756430/JAW.

From A.N.S. International reactor physics conference; Jackson-Hole, USA (18 Sep 1988).

Old measurements and sensitivity studies suggested that the wrong calculations of the reactor temperature coefficient could be explained by the shapes of uranium cross sections in the thermal energy range. New measurements of these neutron data were recently performed. The purpose of this work is to take into account these new measurements, to propose modifications of the evaluated files and to qualify these new shapes by a tendency research method using a set of integral experiments.

14734 **(INIS-SU—64, pp 45-46) Algorithm and program of the geometrical module for reactor lattice three-dimensional calculation.** Rozin, S.G.; Figedi, Sh. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

Algorithm and possibilities of the GBRCD geometrical module for simulation of a particle hystory in a system with complex configuration when calculating the reactor lattice by the Monte Carlo method are described. The module permits to carry out calculations for a medium consisting of separate regions of cylindrical and regular polyhedral configurations. The described module may be used in solving the dosimetry problems. 2 refs.; 1 fig.

14735 **(INIS-SU—64, pp 3-11) Nonlinear one-group theory of a big reactor.** Orlov, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

In the limiting case of a big reactor adequately simple solutions of nonlinear equation for neutron field at deep fuel burnup are obtained. It is shown that nonuniformity of the fuel burnup and regions with high multiplying properties near the reactor boundaries have strong effects on the neutron field spatial stability. The obtained solutions and the perturbation theory may be used for qualitative estimations and quantitative analysis of the reactor performances and its behaviour under different operational conditions. 6 refs.; 3 figs.

14736 **(INIS-SU—64, pp 47-49) Abstract of the PRAKTINEK program.** Sultanov, N.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The PRAKTINEK program (FORTRAN, BESM-6 computer) for one-group kinetic calculation of the LWGR type reactor cluster cell using the method of surface pseudosources in the G/sub N//sup P/-approximation is described. The mean by zones neutron fluxes, neutron fluxes and currents at the cell boundaries, the probabilities of neutron absorption in each zone and the thermal neutron utilization factor are calculated. 4 refs.; 1 fig.

14737 **(INIS-SU—64, pp 49-51) Abstract of the PRAKTINEP(AR) program.** Sultanov, N.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The PRAKTINEP (AR) program (ALGOL-GDR, BESM-6 computer) for a reactor plane cell one-group kinetic calculation by

the surface pseudosource method in the G/sub N/-approximation is described. The thermal neutron utilization factor, mean by zone neutron fluxes, fluxes, currents and second angular moments of neutron distribution function at zone boundaries and the quantity of absorbed neutrons in each zone of a cell are calculated. 7 refs.

14738 (INIS-SU—64, pp 59-61) **Abstract of the KRAB-1MG program complex.** Velikanov, V.V.; Savos'kin, M.M. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The KRAB-1MG program complex (FORTRAN-4, BESM-6 computer) for automation of few-group constant preparation aimed at study of algorithms and finding faults and merits of the collapse method is described. The energy release due to neutron reactions, breeding ratio and its components, distributions of numbers and rates of processes, change in fuel nuclide composition in time, spatial distribution of reactivity coefficients for given nuclides in frames of the first order perturbation theory are calculated. Multi- and few-group equations in the P/sub 1/-approximation with diffusion boundary conditions on an external boundary are used for solving the neutron transport problems. 3 refs.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 14659, 14750, 14753, 14754, 14777, 14815, 16176, 16532, 16533

14739 **(CONF-890310—3) Observations on the behavior of surface flaws in the presence of cladding.** Iskander, S.K.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002320/JAW.

From 7. international conference on fracture; Houston, TX, USA (20 Mar 1989).

A small crack near the inner surface of clad nuclear reactor pressure vessels (RPV) is an important consideration in the safety assessment of the structural integrity of the vessel. Four-point bend tests on large plate specimens, six clad and two unclad, were performed to determine the effect, if any, of stainless steel cladding upon the propagation of small surface cracks subjected to stress states similar to those produced by pressurized thermal shock conditions. Results of tests at temperature 10 and 60{degree}C below the nil-ductility-transition temperature (NDT) have shown that (1) a tough surface layer composed of cladding and/or heat-affected zone has arrested running flaws in clad plates under conditions where unclad plates have ruptured, and (2) the residual load-bearing capacity of clad plates with large subclad flaws significantly exceeded that of an unclad plate. 6 refs., 7 figs., 2 tabs.

14740 (INIS-SU—64, pp 57-58) **Abstract of the ATIKA program.** Bazykov, A.I.; Zharkov, V.P.; Kravchuk, V.G. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The ATIKA program (ALGOL, BESM-6 computer) for two-dimensional multigroup calculation of spatial and energy distribution of the neutron flux density in a nuclear reactor biological shield is described. Diffusion-extraction method is a physical basis of the program. The diffusion component describes the neutron transport in the SP/sub 1/-approximation of the Boltzmann equation expansion by spherical harmonics. A system of algebraic equations is formed using finite difference representation and integration-interpolation method with the five-point approximation of the Laplacian operator. The solution is realized with the help of iterative method of varied directions. The program has a segment-type modular structure. 6 refs.

14741 **(NUREG/CR—5078-Vol.2) A reliability program for emergency diesel generators at nuclear power plants: Maintenance, surveillance, and condition monitoring.** Lofgren, E.V.; Henderson, W.; Burghardt, D.; Kripps, L.; Rothleder, B. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., McLean, VA (USA)). Dec 1988. Contract AC04-76DP00789. 68p. (SAND—87-7176-Vol.2). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89006048/JAW.

This report is a companion report on NUREG/CR-5078, Volume 1, "A Reliability Program for Emergency Diesel Generators at Nuclear Power Plants: Program Structure." The purpose of this report is to provide technical findings and insights related to: failure evaluation, troubleshooting, maintenance, surveillance, and condition monitoring. Examples and recommendations are provided for each of these areas based on actual emergency diesel generator (EDG) operating experience and the opinions of diesel generator experts. This report expands the more general guidance provided in Volume 1. In addition, a discussion of EDG interactions with other plant systems (e.g., instrument, air, service water, dc power) is provided since experience has shown that these support systems and their operation can adversely affect EDG reliability. Portions of this report have been designed for use by onsite personnel for evaluating operational characteristics of EDGs. 5 refs., 8 figs., 7 tabs.

14742 **(NUREG/CR—5265) Size effects on J-R curves for A 302-B plate.** Hiser, A.L.; Terrell, J.B. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Materials Engineering Associates, Inc., Lanham, MD (USA)). Jan 1989. 300p. (MEA—2320). NTIS, PC A13/MF A01 - GPO - OSTI. Order Number TI89006473/JAW.

This study was initially conceived to determine J-R curves from various sizes of specimens to investigate data extrapolation from small size specimens. Instead, this study resulted in the finding of a significant size effect or dependence for the low toughness A 302-B plate investigated. In particular the magnitude of this size dependence is unprecedented for reactor pressure vessel steels. The observed size dependence results in vastly reduced J-R curve toughness levels with increased specimen size, for compact specimens ranging in thickness from 12.7 to 152.4 mm, with all specimens proportional in terms of dimensions. The plate used in this study was specially made to duplicate early production A 302-B plates, which typically exhibit low Charpy-V upper shelf energy levels. The minimal cross-rolling applied to the plate and the high sulfur content result in a high proportion of manganese-sulfide inclusions. The resultant microstructure is one possible explanation for the unexpected results for this plate. Other causes and ideas for future work are also described. An additional observation is that initial crack length-to-width ratio (a/W) did have an influence on the J-R curves for this plate. Specifically, a long crack length (a/W {approximately} 0.6) can give somewhat higher J-R curve levels than a short crack length (a/W {approximately} 0.5), for large Δa levels. This finding has a direct impact on the applicability of J/sub D/ and J/sub M/, and data extrapolation. 23 refs., 91 figs., 12 tabs.

14743 **A consistent and cost-effective quantification of containment performance criteria.** Park, C.K.; Bari, R.A. (Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY (US)); Kerr, W. (Univ. of Michigan, Dept. of Nuclear Engineering, Ann Arbor, MI (US));. *Nuclear Technology;* **81**: No. 3, 360-369(Jun 1988).

Containment performance criteria (CPC) are derived systematically, given top level safety goals related to public risk. The main focus is on the relationships between the top level safety goals and lower level design objectives, and the way in which the latter are determined. A set of CPC is identified in terms of the reliabilities of the systems that perform various containment functions. The multiobjective optimization approach is used as a method for deriving a finite manageable set of self-consistent relations between the top level safety goals and specific containment performance. As a global set of measures of plant performance or objective functions, acute and latent fatalities and the total reliability cost are chosen.

The latter is included because it represents both technical and economic limitations in achieving a certain level of the first two members of the global set. A specific application is made to a large dry containment. A set of noninferior solutions (optimized solutions in a multi-objective optimization problem) is shown and discussed.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 15708

14744 **(INIS-SU—64, pp 55-56) Abstract of the LUSO program.** Ajrapetyan, A.A.; Shevelev, Ya.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The LUSO program (FORTRAN-4, ES computers) for calculation of optimum distribution of fuel assemblies in the reactor core and for estimation of economical damage of fuel element failure is described. A specially developed one-group, one-dimensional, three-zone, highly simplified model is used. 1 ref.

14745 **(INIS-SU—64, pp 63-64) Abstract of the RNDT program.** Zheltukhin, K.K.; Ul'yanov, A.I. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The RNDT program (FORTRAN-CERN, BESM-6 computer) for calculation of deformed-stressed state of fuel elements with continuous or hollow pellet rods in the case of tight fuel-cladding bond is described. The fuel element is represented as two endless cylinders with tight bond in axial and radial directions. A fuel element being under the effect of nonstationary fields of radiation and temperature loaded by internal and external pressures as well as by an axial force is considered. The theories of thermoradiation plasticity and Birger type creep are used to solve the problem. 2 refs.

2204 Control Systems

REFER ALSO TO CITATION(S) 14447, 14457, 14683, 14721, 14819, 14823, 14832

14746 **(BMU—1988-193) Acoustic monitoring in light water reactors. International status.** Olma, B.J.; Schuetz, B. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1988. 90p. (In German). (GRS-A—1440). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Acoustic monitoring for detection of loose parts at the pressure retaining boundary of LWR has been established as a powerful tool for early failure detection in all important NPP-operating countries (Federal Republic of Germany, USA, France, Japan, Belgium, Netherlands, GDR, Czechoslovakia). Adequate measurement systems and analysis methods have been developed and are now used in nearly all reactors in an operational manner. The present report describes the international status of acoustic monitoring and summarizes the activities in the relevant NPP-operating countries. The following topics are discussed, as far as they are known in detail: The experiences which led to utilization of acoustic monitoring in the corresponding country, the instrumentation concept and the state of application, regulatory requirements, the state of knowledge concerning signal interpretation as well as problem-specific tropics; particularly, actual developments are addressed as they are documented by R and D-activities or formulation of standards and regulatories. Trends of development are discussed, recommendations for future activities are given.

14747 **(CONF-881252—1) A survey of control rod measurements in ZPPR and their analysis.** Collins, P.J. (Argonne National Lab., Idaho Falls, ID (USA)). 1988. Contract W-31109-ENG-38. 44p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004199/JAW.

From IAEA specialists' meeting; Winfrith, UK (6 Dec 1988).

The accurate prediction of control rod worths has been of great concern in the United States. Optimum control configurations need to balance several often conflicting requirements of control through the operating cycle, while maintaining acceptable power shapes, safety considerations of overriding importance, together with seeking economy by minimizing the number of rods, reducing boron enrichment and lengthening replacement intervals. After control and shutdown requirements have been met, the most important safety concern is the transient overpower condition (TOP) which may be initiated by uncontrolled run-out of a primary rod. Stringent criteria for the primary and secondary systems may be that they are independently capable of shutting down the reactor even with one rod stuck. The TOP initiator may be greatly enhanced by control rod interaction effects. Control rod effects may have a strong impact on core design. For example, work on the integral fast reactor with metallic fuel at ANL has studied core designs which minimize the TOP reactivity by maintaining a minimum primary control bank insertion through tailoring the internal breeding gain. The predicted control rod worths are very sensitive to the calculation methods used and to the accuracy of the basic nuclear data files. Required accuracies have been achieved only through the use of critical experiments on the ZPR and ZPPR facilities. Experiments on ZPR-3 and ZPR-9 produced satisfactory control predictions for the SEFOR, EBR-II and FFTF reactors. This document provides a survey of control rod measurements and compares calculated and experimental results. 16 refs., 3 figs., 10 tabs.

14748 **(DOE/NE/37959—26) Generalized consistency checking of multivariable redundant measurements (GCCM) and common-mode failure detection.** Glockler, O.; Upadhyaya, B.R.; Morgenstern, V.M. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Jan 1989. Contract AC02-86NE37959. 148p. NTIS, PC A08 - OSTI. Order Number DE89007219/JAW.

The limitations of the single-variable consistency checking algorithm for validating redundant measurements are remedied by extending the algorithm to multivariable signals. The redundant measurements of each variable in a subsystem are combined with an estimation of the variable using prediction model. A complex logic algorithm has been developed to perform simultaneous consistency checking of all the variables under consideration. The overall objectives of the generalized consistency checking of multivariable signals (GCCM) are: to separate sensor fault (bias decalibration) from normal changes in the system, and to detect and isolate common-mode sensor failures (indicating correlation in sensor failures). The new algorithm has been implemented in a general purpose PC and in the Micro VAX-II workstation. Both simulated signals and operation data from a four-loop Westinghouse PWR have been used to test the algorithm. This module is being incorporated into the overall signal validation system. Because of the completeness of cross comparison variables, the use of model-based prediction and the use of measurement redundancy, the logic for detecting instrument degradation can be extended to the monitoring of actuator anomaly. The latter is an important aspect of system diagnostics, and may be considered as a dual problem to that of signal validation. 3 refs., 118 figs., 37 tabs.

14749 **(DP-MS—88-98) Real-time, multitasking control system for reactor inspection robots.** Byrne, T.J.; Jenkins, J.B.; Lewis, W.I.; Park, L.R.; Reeves, G.E. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 8p. (CONF-890304—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002455/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Equipment Engineering Division of the Department of Energy's Savannah River Laboratory in Aiken, South Carolina has developed a remote system to perform ultrasonic (UT) and eddy

current (ET) wall weld inspections inside the nuclear reactors at the site. The basic components of the inspection system include an inspection robot and control hardware, a supervisory computer, and ultrasonic and eddy current data collection and analysis computers. The ultrasonic and eddy current systems are responsible for driving the transducers, and digitizing, displaying, and storing the information. 7 figs.

14750 **(EPRI-CS—6080) Proceedings: 1987 conference on expert-system applications in power plants.** (Electric Power Research Inst., Palo Alto, CA (USA); Expert-EASE Systems, Inc., Belmont, CA (USA)). Dec 1988. 614p. (CONF-8705332—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89005328/JAW.

From EPRI conference on expert-system applications in power plants; Boston, MA, USA (27 May 1987).

The third EPRI conference on expert system applications for the electric utilities was held in Boston on May 27--29, 1987. The conference was co-hosted by Boston Edison Company and Niagara Mohawk Power Corporation and it was attended by more than 300 attendees from the US, Europe and Japan. The participants represented a broad spectrum of utilities, equipment manufacturers, engineering consultants, university faculty, and members of the federal and state regulatory agencies. Many applications of expert systems have emerged recently and many of the vendors now have meaningful prototypes that can demonstrate the benefits of expert systems to the utilities. Several utilities also have prototypes working at this time; but more importantly, the utilities have advanced significantly in their understanding and appreciation of this technology. Many utilities have organized teams within their organizations that have the charter of evaluating the leading applications and developing associated plans for the implementation of these applications. The conference identified several areas that are important to the utilities: training of the utility staff in the basic technology to rapidly build the appropriate infrastructure; review and recommendations in selection of hardware and software tools. This is needed since there is a very rapid change both in the market place as well as in terms of technical progress; dissemination of examples of good applications that directly relate to the power industry would be very helpful in relating to how the technology can be used; and coordination of the development of expert system applications among the utilities. This is needed since expert system applications typically are expensive to develop, but also relatively easy to transfer from one utility to another.

14751 **(EPRI-NP—6170-M) FATIGUEPRO on-line fatigue monitoring system: Demonstration at the Quad Cities BWR [boiling water reactor]: Final report.** Riccardella, P.C.; Deardorff, A.F.; Tang, S.S.; Gustin, H.L. (Electric Power Research Inst., Palo Alto, CA (USA); Structural Integrity Associates, San Jose, CA (USA)). Jan 1989. 96p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006843/JAW.

The objective of this research project was to demonstrate the methodology for evaluating fatigue usage accumulation at the feedwater nozzle locations in a boiling water reactor (BWR) using existing instrumentation and available plant operating data. The resulting methodology permits cumulative fatigue usage to be monitored and tracked based on actual plant operating cycles rather than by counting cycles for a pre-determined set of design transients. This phase of the project has resulted in improvements to the fatigue monitoring methodology which have been implemented in a software system called FatiguePro. A prototype system had been previously installed and tested for a limited number of locations at the San Onofre 2 pressurized water reactor. In this project phase, an additional pilot plant study has been conducted at the Quad Cities Nuclear Power Station (Unit 2) to demonstrate the feasibility of such an on-line fatigue usage transient monitoring system for a boiling water reactor. 23 figs., 5 tabs.

14752 (INIS-SU—64, pp 11-14) **On the modification of the technique for reconstructing power distribution in reactors using the in-core detector data.** Akimov, I.S.; Tukhvetov, F.T. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The two known methods of determining the power distribution in reactors based on joint use of two-dimensional physical calculations and in-core measurements are considered. Their faults and merits are discussed, the modified technique practically not complicating the calculations is suggested. 5 refs.

14753 **Work-in-progress report on maintenance good practices for motors in nuclear power generating stations - Part 2.** Eckstein, E.R. (Carolina Power and Light Co. (US)); Hall, A.R. (Florida Power and Light Co.); Kasper, S. (General ELectric Co.); Smith, P.R. (Engineering Planning and Management); Subudhi, M. (Brookhaven National Lab.);. *IEEE Transactions on Power Electronics;* **3**: No. 3, 596-600(Sep 1988).

Motor maintenance is addressed by a variety of industry standards, utility procedures and manufacture's insiructions, as well as by recently published assessments of nuclear and non-nuclear operating experience and motor reliability data. This experience supports the premise that motor failure rates are in large part related to application stress factors such as operating time, environmental factors and vibration. Due to the large number of critical motors installed in a nuclear generating station, additional considerations are necessary to effectively schedule their preventive maintenance activities. Therefore, in this part, a method for prioritizing motor maintenance based on application stresses experienced by the motors is presented.

14754 **Work-in-progress report on maintenance good practices for motors in nuclear power generating stations - Part 1.** Eckstein, E.R. (Carolina Power and Light Co. (US)); Hall, A.R. (Florida Power and Light Co.); Kasper, S. (General Electric Co.); Smith, P.R. (Engineering Planning and Management); Subudhi, M. (Brookhaven National Lab.);. *IEEE Transactions on Power Electronics;* **3**: No. 3, 589-595(Sep 1988).

Motor maintenance is addressed by a variety of industry standards, utility procedures and manufacturer instructions, as well as by recently published assessments of nuclear and non-nuclear operating experience and motor reliability data. Nuclear utilities must select effective maintenance practices from these sources, while giving due consideration to their own particular experience. In this paper, good practices for preventive maintenance of motors are recommended which address the most frequent causes of motor failures. Due to the large number of critical motors installed in a nuclear generating station, the problem of prioritizing motors for preventive maintenance has been addressed in Part 2, a companion paper.

14755 **Intrusion detection and entry control at the Savannah River Plant reactors.** Reeve, H.R.; Cato, A.R.; Bell, T.C. (E.I. du Pont de Nemours and Co., Inc., Savannah River Plant, Aiken, SC (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 760-763(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

E.I. du Pont de Nemours and Company, prime contractor to the Department of Energy, currently operates three nuclear reactors for defense material production at the Savannah River Plant. A highly successful safeguards intrusion detection and access control system, in compliance with DOE Order 5632.4, has been in operation at the reactor sites since September 1984. This paper describes the three-sensor intrusion detection system and the three-parameter access control system, and it gives the maintenance experience for major system components based upon 6 system years of operation. Mean time between failure rates between 0.7 and 345.6 months have been experienced. Key points to the establishment of a successful maintenance program are discussed.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 14455, 14753, 14812, 14826, 14828, 14830, 14864, 14865, 15972, 15973

14756 **(CEGB-RD/B—6027/R88) Improved estimates of external gamma dose rates in the environs of Hinkley Point Power Station.** Macdonald, H.F.; Thompson, I.M.G.; Foster, P.M.; Robins, A.G. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.; Central Electricity Research Labs., Leatherhead (UK)). (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1988. 84p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705315/JAW.

The dominant source of external gamma dose rates at centres of population within a few kilometres of Hinkley Point Power Station is the routine discharge of 41-Ar from the 'A' station magnox reactors. Earlier estimates of the 41-Ar radiation dose rates were based upon measured discharge rates, combined with calculations using standard plume dispersion and cloud-gamma integration models. This report presents improved dose estimates derived from environmental gamma dose rate measurements made at distances up to about 1 km from the site, thus minimising the degree of extrapolation introduced in estimating dose rates at locations up to a few kilometres from the site. In addition, results from associated chemical tracer measurements and wind tunnel simulations covering distances up to about 4 km from the station are outlined. These provide information on the spatial distribution of the 41-Ar plume during the initial stages of its dispersion, including effects due to plume buoyancy and momentum and behaviour under light wind conditions. In addition to supporting the methodology used for the 41-Ar dose calculations, this information is also of generic interest in the treatment of a range of operational and accidental releases from nuclear power station sites and will assist in the development and validation of existing environmental models.

14757 **(CONF-8806143—7) Fissior product release from core-concrete mixtures.** Roche, M.F.; Settle, J.; Leibowitz, L.; Johnson, C.E.; Ritzman, R.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005837/JAW.

From 2. nuclear reactor severe accident chemistry symposium; Toronto, Canada (5 Jun 1988).

The objective of this research is to measure the amount of strontium, barium, and lanthanum that is vaporized from core-concrete mixtures. The measurements are being done using a transpiration method. Mixtures of limestone-aggregated concrete, urania doped with a small amount of La, Sr, Ba, and Zr oxides, and stainless steel were vaporized at 2150 K from a zirconia crucible into flowing He-6% H_2-0.06% H_2O (a partial molar free energy of oxygen of -420 kJ). The amounts that were vaporized was determined by weight change and by chemical analyses on condensates. The major phases present in the mixture were inferred from electron probe microanalysis (EPM). They were: (1) urania containing calcia and zirconia, (2) calcium zirconate, (3) a calcium magnesium silicate, and (4) magnesia. About 10% of the zirconia crucible was dissolved by the concrete-urania mixture during the experiment, which accounts for the presence of zirconia-containing major phases. To circumvent the problem of zirconia dissolution, we repeated the experiments using mixtures of the limestone-aggregate concrete and the doped urania in molybdenum crucibles. These studies show that thermodynamic calculations of the release of refractory fission products will yield release fractions that are a factor of sixteen too high if the effects of zirconate formation are ignored.

14758 **(EGG-M—33587) Fission product behavior during the in-pile Severe Fuel Damage Test SFD 1-4.** Vinjamuri, K.; Osetek, D.J.; Petti, D.A.; Meikrantz, D.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 17p. (CONF-8806143—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005187/JAW.

From 2. nuclear reactor severe accident chemistry symposium; Toronto, Canada (5 Jun 1988).

Fission product behavior during Severe Fuel Damage (SFD) Test SFD 1-4 is discussed in this paper. The SFD 1-4 fuel bundle consisted of 26 previously irradiated (36000 MWd/tU) and 2 fresh pressurized-water-reactor fuel rods, and 4 stainless-steel clad Ag-In-Cd control rods. The 1-m bundle was heated to temperatures in excess of 2400 K during the test to reproduce temperature, fuel damage, fission product release, hydrogen generation, and control rod material behavior that are representative of a small break loss of coolant accident in a light-water-reactor. Samples of the effluent exiting the damaged fuel bundle consisting of superheated steam, fission products, aerosols, and noncondensable gases were collected and analyzed. Measurements of deposition on sample system surfaces were also made. The samples were analyzed using a variety of analytical techniques to provide an understanding of the release, transport and deposition of fission products. The results are presented in terms of release fractions, release rates and the distribution of fission products. The probable chemical forms of the predominant fission product species are inferred from the solubility, transport and deposition behavior of key isotopes. 9 refs.

14759 **(NUREG—0800) Standard review plan for the review of safety analysis reports for nuclear power plants.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1988. 7p. NTIS, PC A02/MF A01 - GPO - OSTI. Order Number TI89006503/JAW.

This section resolved an inconsistency in NRC regulatory guidance by giving credit to pressure suppression pools as post-accident fission product cleanup systems in boiling water reactors. 8 refs.

14760 **(NUREG—0837-Vol.8-No.3) NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, July--September 1988.** Struckmeyer, R.; McNamara, N. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Jan 1989. 224p. NTIS, PC A10/MF A01 - GPO - OSTI. Order Number TI89006381/JAW.

The US Nuclear Regulatory Commission (NRC) Direct Radiation Monitoring Network is operated by the NRC in cooperation with participating states to provide continuous measurement of the ambient radiation levels around licensed NRC facilities, primarily power reactors. Ambient radiation levels result from naturally occurring radionuclides present in the soil, cosmic radiation constantly bombarding the earth from outer space, and the contribution, if any, from the monitored facilities and other man-made sources. The Network is intended to measure radiation levels during routine facility operations and to establish background radiation levels used to assess the radiological impact of an unusual condition, such as an accident. This report presents the radiation levels measured around all facilities in the Network for the third quarter of 1988. A complete listing of the site facilities monitored is included. In some instances, two power reactor facilities are monitored by the same set of dosimeters. All radiation measurements are made using small, passive detectors called thermoluminescent dosimeters (TLDs), which provide a quantitative measurement of the radiation levels in the area in which they are placed. Each site is monitored by arranging approximately 40 to 50 TLD stations in two concentric rings extending to about five miles from the facility. All TLD stations are outside the site boundary of the facility.

14761 **(PNL—6807) Neutron measurements of the fuel remaining in the TMI II once-through steam generators (OTSG'S).** Geelhood, B.D.; Abel, K.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 111p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006808/JAW.

Polypropylene tubes containing a string of 18 copper rods were inserted into the lower head region and each J-leg of the two once-through steam generators (OTSG) of the unit two reactor at Three Mile Island. The object was to measure the neutron flux present in those regions and estimate the amount of residual fuel remaining in each OTSG. The neutron flux from any residual fuel induces a radioisotope, ^{64}Cu, in the copper coupons. The ^{64}Cu activity is detected by coincidence counting the two 511-keV gamma rays produced by the annihilation of the positron emitted in the decay of ^{64}Cu. The copper coupons were placed between two 6-

inch diameter, 6-inch long NaI(Tl) crystals and the electronics produced a coincidence count whenever the two gamma rays were uniquely detected. The net coincidence count is proportional to the amount of ^{64}Cu activity in the coupon. This document discusses calculation methods, statistical methods, and results of this research. 3 figs., 30 tabs.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 14780, 16529

14762 (CONF-8809221—2) Fuel element powers, ^{235}U masses, and burnups from gamma-scanning data: Preliminary analysis of irradiated ORR [Oak Ridge Research Reactor] LEU fuel elements. Bretscher, M.M.; Snelgrove, J.L.; Hobbs, R.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005832/JAW.

From International meeting on reduced enrichment for research and test reactors (RERTR); San Diego, CA, USA (18 Sep 1988).

Fuel elements used in the ORR whole-core LEU fuel demonstration have been gamma-scanned to determine axial distributions of ^{149}La and ^{137}Cs fission product activities. This data has been analyzed to determine cycle-averaged fuel element powers, residual ^{235}U masses, and burnups of discharged fuel elements. Methods used to analyze the data are discussed and results are presented for the LEU fuel elements. Measured and calculates fuel element powers agree to within 5%, residual ^{235}U masses to within 2%, and burnups to within 3%. These results are somewhat preliminary and await improved burnup calculations and independent calibration data to be based on the destructive analyses of a number of irradiated fuel elements. 4 refs., 7 figs., 3 tabs.

14763 (GKSS—88/E/44) Backfitting measures for the research reactors FMRB, FRG-1 and FRG-2. Hajek, W.; Kriks, H.J.; Krull, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Zentralabteilung Forschungsreaktoren). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Zentralabteilung Forschungsreaktoren). 1988. 5p. (In German). Special print from Atomwirtsch., Atomtech. (Aug-Sep 1988) v. 33(8/9) p. 454-457.

According to IAEA statistics, more than 300 research reactors are in operation worldwide with power levels ranging between several milliwatts and the 250 MW Advanced Test Reactor in Idaho, USA. With research reactors of the ≧ 100 kW power category, impacts on third parties of accidents in these reactors cannot be excluded. Consequently, the safety status of these reactors must be, and will be, inspected whenever plant modifications become necessary. In Western Europe, 35 research reactors with powers ≧ 100 kW are at present in operation. More than seventy percent of the reactors were purchased over twenty years ago. The average age of the research reactors still in operation is 24.2 years. Examples of backfitting measures and of the adaptation to the current state of the art are represented by the research reactors in Brunswick (FMRB) and in Geesthacht (FRG-1 and FRG-2), which are discussed in detail in the report.

14764 (IAEA-R—3422-F) Application of PSA to reduce frequency of unplanned shutdown of the reactor. Final report for the period 1 April 1983 - 31 March 1988. Tanipanichskul, P. (Office of Atomic Energy for Peace, Bangkok (Thailand)). (International Atomic Energy Agency, Vienna (Austria)). Aug 1988. 74p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705326/JAW.

The relative importance of all the operating and safety systems of the reactor TRR-1/M1 as well as the major failure modes of the systems are pointed out. The average unavailability of the reactor is 3center dot3 E-2 per cycle of operation which is in the range value of the actual reactor shutdown recorded during normal operation. Some guidance for annual maintenance and also suggestions for system development to increase safety systems reliability are determined. PSA was applied to improve the safety systems reliability of an operating research reactor. Refs, tabs.

14765 (INIS-SU—64, pp 52-53) Abstract of the TDD-S/4 program. Arkhangel'skij, N.V.; Nasonov, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The TDD-C/4 program (FORTRAN-CERN, BESM-6 computer) for three-dimensional calculation of the IRT-M reactor fuel assemblies in the two-group diffusion approximation is described. The efficient neutron multiplication factor, neutron flux density, power density, power density nonuniformity factors by cells, coefficients of heat flux density nonuniformity on the surface of fuel elements are calculated. The system of mesh equations is solved using the method of successive upper relaxation with optimum relaxation factor. 5 refs.

14766 (INIS-SU—68, pp 576) On light-generating nuclear reactors. Cherkasov, A.S.; Kovtun, V.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

14767 (IWGGCR—16, pp 42-43) Status of HTTR development in Japan. Sanokawa, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). Jun 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88705384/JAW. (CONF-8710436—).

From 7. meeting of the International Working Group on Gas-Cooled Reactors; Beckum, F.R. Germany (29 Oct 1987).

The Japanese Atomic Energy Commission decided to construct a high-temperature engineering test reactor in order to promote innovative basic research on high-temperature engineering as well as advanced HTGR technology. The reactor design and the related R and D works carried out in reactor physics, fuel and materials are briefly presented in this report.

14768 (Juel-Spez—462) Post-irradiation studies of test plates for low enriched fuel elements for research reactors. Groos, E.; Buecker, H.J.; Derz, H.; Schroeder, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Jul 1988. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756618/JAW.

In developing new fuels for research reactor elements that allow the use of low enriched uranium (LEU) < 20% U-235) with higher densities testplates with uranium silicide of different compositions were fabricated by NUKEM and irradiated at the FRJ-2. The following silicide fuels have been tested: U/sub 3/Si/sub 2/, U/sub 3/Si/sub 1.5/, U/sub 3/Si/sub 1.3/ and U/sub 3/Si. Even up to high burnup rates (80% fifa) U/sub 3/Si/sub 2/ was proved to be a reliable fuel that according to the test results achieved to date complies with all necessary requirements above all with respect to dimensional stability. U/sub 3/Si showed significant changes of the fuel microstructure associated with considerably higher fuel swelling, that will probably exclude its use in research reactor operation. The irradiation of U/sub 3/Si/sub 1.3/ and U/sub 3/Si/sub 1.5/ plates had to be terminated untimely. Up to a burnup of 40% fifa these plates behaved quite well. An extrapolation to higher burnup rates, however only seems to be possible with reservations.

14769 (LLB—87-01) Orphee reactor experimental equipment. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1987. 175p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756686/JAW.

Experimental equipment around the ORPHEE reactor is presented. The neutron source; and the spectrometers and sample environment (inelastic and quasi-elastic scattering, elastic scattering,

spread scattering, small angle scattering) are described. An experiment proposal and reports guide is supplied.

14770 **Real-time neutron radiography system performance - Measurements and methods.** Sulcoski, M.F. (Univ. of Virginia, Nuclear Engineering and Engineering Physics, Charlottesville, VA (US)); Tobin, K.W. (Oak Ridge National Lab., Enrichment Technology Applications Center, Oak Ridge, TN (US)); Brenizer, J.S. Jr. (Univ. of Virginia, Nuclear Engineering and Engineering Physics, Charlottesville, VA (US));. *Nuclear Technology;* **82**: No. 3, 355(Sep 1988).

The University of Virginia's real-time neutron radiography facility was characterized by measurement of the total neutron flux, gold/cadmium ratio, neutron/gamma ratio, and the effective collimar length-to-aperture diameter (L/D) ratio. The real-time neutron imaging system and collimator were further characterized by measuring the modulation transfer function (MTF) of the system. The collimator effectiveness was measured by using the MTF to determine the "unparallelism" of the neutron beam. The computer-based image processing system allowed rapid calculation of the MTF and the collimator effectiveness. The results of these measurements, using no collimator and a simple tube collimator, demonstrated the method's ability to determine the effective L/D ratio. The MTF measurement scheme provided a fast, reliable, and reproducible means of monitoring any changes in the real-time system, including both the neutron beam and the electronic components. This paper describes the methods and measurements implemented to characterize the changes in the radiographic system performance. These include standard measurements of the neutron, flux, neutron-to-gamma ratio, the effective collimator length-to-aperture diameter (L/D) ratio, and effective neutron temperature.

14771 **Onset of nucleate boiling in research reactors with thin rectangular channels under low-velocity upward-flow conditions.** Belhadj, M.; Aldemir, T.; Christensen, R.N. (The Ohio State Univ., Dept. of Mechanical Engineering, Nuclear Engineering Program, 206 West 18th Avenue, Columbus, OH (US));. *Nuclear Technology;* **82**: No. 3, 330-340(Sep 1988).

Currently used correlations to predict the onset of nucleate boiling heat flux q/sup "//sub ONB/ in research reactor channels determine q/sup "//sub ONB/ in terms of local channel pressure and wall superheat. Recent experiments show that these correlations may over- or underestimate q/sup "//sub ONB/ by as much as a factor of 5 in thin rectangular channels for low-velocity upward flows. Such flow conditions are encountered in the natural convection cooling of research reactors with plate-type fuels. A set of experiments are performed to quantify the effect of channel flow velocity and gap size (in the ranges of 2 to 14 cm/s and 2 to 4 mm, respectively) on q/sup "//sub ONB/ for upward flow in rectangular channels. An adjustable gap between two internally heated aluminum blocks forms the flow channel. A new correlation is proposed that predicts the experimental q/sup "//sub ONB/ results within 13% for flows with Re $<$ 700 (Re based on channel gap) and that is valid in the 1.40- to 1.46-atm pressure range.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 14455, 14770, 14828, 15626

14772 **(DP-MS—88-244) Automated office support systems (AOSS): Savannah River Plant site summary.** Kaplan, M.; Willis, T.; Butterworth, B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1989. Contract AC09-76SR00001. 11p. (CONF-890159—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005401/JAW.

From Mini/Micro Computer Information Interchange Group meeting; Tampa, FL, USA (4 Jan 1989).

Savannah River Plant (SRP) is the sole supplier of special nuclear materials used in the nation's nuclear defense program and its primary products are plutonium and tritium. The site is located just south of Aiken, South Carolina on a 300 square mile reservation whose western border is the Savannah River. There are approximately 16,000 personnel employed at the site. In 1985, SRP commissioned a study to determine what additional computing resources should be funded to meet the information needs of the site. Computer Projects Department (CPD) began as an outgrowth of that study and was charged with implementing recommendations of the report including installing extensive local area networks linking personal computer workstations and installing Office Automation and Computer Aided Design computers and linking them to the network. These links are reviewed in this paper.

14773 **Isotope correlation verification of analytical measurements for dissolver materials.** Satkowski, J. (E.I. du Pont de Nemours and Co., Savannah River Plant, Aiken, SC (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 710-712(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

An independent verification of analytical results for accountability measurements of dissolver materials can be performed using the Isotop Correlation Technique (ICT). ICT is based on the relationships that exist between the initial and final elemental concentration and isotopic abundances of the nuclear fuel. Linear correlation functions between isotopic ratios and plutonium/uranium ratios have been developed for specific reactor fuels. The application of these correlations to already existing analytical data provides a laboratory additional confidence in the reported results. Confirmation is done by a test of consistancy with historical data. ICT is being utilized with dissolver accountability measurements at the Savannah River Plant Laboratory. The application, implementation, and operating experience of this technique are presented.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 14372, 14658, 14683, 14725, 14728, 14743, 14753, 14754, 14757, 14758, 14866, 15694, 15712, 16131

14774 **(BMU—1988-197) Fundamental theoretical considerations on aerosol condensation.** Pana, P. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). May 1988. 37p. (In German). (GRS-A—1439). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Under accident conditions in a PWR plant the behavior of aerosoles in the containment was closely examined with or without consideration of thermodynamic equilibrium. Comparative calculations have shown, that under quasi static accident conditions in a containment the determination of the rate of condensation in space without considering thermodynamic equilibrium is acceptable. As a result, an essential simplification for the solution of the whole problem is achieved. It will be clear that the condensation on the one hand and the aerosol behavior on the other hand can be caluclated by two independent and separate codes.

14775 **(BNL-NUREG—42157) Quantifying reactor safety margins: Application of CSAU [Code Scalability, Applicability and Uncertainty] methodology to LBLOCA: Part 3, Assessment and ranging of parameters for the uncertainty analysis of LBLOCA codes.** Wulff, W.; Boyack, B.E.; Duffey, R.B.; Griffith, P.; Katsma, K.R.; Lellouche, G.S.; Levy, S.; Rohatgi, U.S.; Wilson, G.E.; Zuber, N. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 56p. (CONF-8810155—38). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006180/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

Comparisons of results from TRAC-PF1/MOD1 code calculations with measurements from Separate Effects Tests, and published experimental data for modeling parameters have been used to determine the uncertainty ranges of code input and modeling parameters which dominate the uncertainty in predicting the Peak Clad Temperature for a postulated Large Break Loss of Coolant Accident (LBLOCA) in a four-loop Westinghouse Pressurized Water Reactor. The uncertainty ranges are used for a detailed sta-

tistical analysis to calculate the probability distribution function for the TRAC code-predicted Peak Clad Temperature, as is described in an attendant paper. Measurements from Separate Effects Tests and Integral Effects Tests have been compared with results from corresponding TRAC-PF1/MOD1 code calculations to determine globally the total uncertainty in predicting the Peak Clad Temperature for LBLOCAs. This determination is in support of the detailed statistical analysis mentioned above. The analyses presented here account for uncertainties in input parameters, in modeling and scaling, in computing and in measurements. The analyses are an important part of the work needed to implement the Code Scalability, Applicability and Uncertainty (CSAU) methodology. CSAU is needed to determine the suitability of a computer code for reactor safety analyses and the uncertainty in computer predictions. The results presented here are used to estimate the safety margin of a particular nuclear reactor power plant for a postulated accident. 25 refs., 10 figs., 11 tabs.

14776 **(BNL-NUREG—42166) Utilization of aging program results in plant inspections.** Gunther, W.; Fullwood, R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-8810155—40). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006174/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

Research conducted under the auspices of the US Nuclear Regulatory Commission Nuclear Plant Aging Research (NPAR) Program has resulted in a large data base of component and system operating experience. This data base has been used to determine equipment aging susceptibility and the potential for equipment aging to impact plant safety and reliability. Methods of detecting and mitigating component and system aging have also been identified. This paper discusses how the NPAR results could be used to focus inspection activities on age-sensitive components and systems and on the specific modes and mechanisms of age degradation. These activities range from the regular inspections conducted by resident inspectors to extensive special inspections such as the Safety System Functional Inspection typically conducted by a team of inspectors. 5 refs., 3 figs., 1 tab.

14777 **(BNL-NUREG—42169) PRAAGE-1988: An interactive IBM-PC code for aging analysis of NUREG-1150 systems.** Fullwood, R.R.; Shier, W.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-8810155—39). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006173/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

Probabilistic Risk Assessments (PRA) contain a great deal of information for estimating the risk of a nuclear power plant but do not consider aging. PRAAGE (PRA+AGE) is an interactive, IBM-PC code for processing PRA-developed system models using non-aged failure rate data in conjunction with user-supplied time-dependent nuclear plant experience component failure rate data to determine the effects of component aging on a system's reliability as well as providing the age-dependent importances of various generic components. This paper describes the structure, use and application of PRAAGE to the aging analysis of the Peach Bottom 2 RHR system in the LPCI and SDC modes of operation. 4 refs., 15 figs., 5 tabs.

14778 **(CEA-CONF—9655) Analysis of a control rod ejection transient in a MOX-fuelled PWR.** Lenain, R.; Mathonniere, G.; Perrutel, J.P.; Schaeffer, H.; Stelletta, S.; Lam Hime, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Electricite de France, 92 - Clamart; Electricite de France, 69 - Lyon. Region d'Equipement). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 10p. (CONF-8809229—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756427/JAW.

From A.N.S. International reactor physics conference; Jackson-Hole, USA (18 Sep 1988).

The decision to use mixed-oxide (MOX) fuel in PWR's involved re-investigation of a certain number of accidents and notably control rod ejection transients. It has thus been shown that this accident would be no more severe than in the case of all-uranium cores, since the positive effects on the ejected rod worth would counterbalance the negative effects on the delayed neutron fraction. A new approach to the kinetics aspect of the calculation method for this accident is also presented, involving a 3-D kinetic calculation with only a few axial meshes.

14779 **(CONF-880911—29) Trends vs. reactor size of passive reactivity shutdown and control performance.** Wade, D.C.; Fujita, E.K. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005846/JAW.

From International reactor physics conference; Jackson Hole, WY, USA (18 Sep 1988).

The focus of the US advanced reactor program since the cancellation of CRBR has been on inherent safety and cost reduction. The notion is to so design the reactor that in the event of an off normal condition, it brings itself to a safe shutdown condition and removes decay heat by reliance on "inherent processes" i.e., without reliance on devices requiring switching and outside sources of power. Such a reactor design would offer the potential to eliminate costly "Engineered Safety Features," to lower capital costs, and to assuage public unease concerning reactor safety. For LMR concepts, the goal of passive reactivity shutdown has been approached in the US by designing the reactors for favorable relationships among the power, power/flow, and inlet temperature coefficients of reactivity, for high internal conversion ratio (yielding small burnup control swing), and for a primary pump coastdown time appropriately matched to the delayed neutron hold back of power decay upon negative reactivity input. The use of sodium bonded metallic fuel pins has facilitated the achievement of the passive shutdown design goals as a consequence of their high thermal conductivity and high effective heavy metal density. Alternately, core designs based on derated oxide pins may be able to achieve the passive shutdown features at the cost of larger core volume and increased initial fissile inventory. 8 refs., 12 figs., 1 tab.

14780 **(CONF-8810155—41) Impact of radiation embrittlement on integrity of pressure vessel supports for two PWR [pressurized-water-reactor] plants.** Cheverton, R.D.; Pennell, W.E.; Robinson, G.C.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006625/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

Recent pressure-vessel surveillance data from the High Flux Isotope Reactor (HFIR) indicate an embrittlement fluence-rate effect that is applicable to the evaluation of the integrity of light-water reactor (LWR) pressure vessel supports. A preliminary evaluation using the HFIR data indicated increases in the nil ductility transition temperature at 32 effective full-power years (EFPY) of 100 to 130{degree}C for pressurized-water-reactor (PWR) vessel supports located in the cavity at midheight of the core. This result indicated a potential problem with regard to life expectancy. However, an accurate assessment required a detailed, specific-plant, fracture-mechanics analysis. After a survey and cursory evaluation of all LWR plants, two PWR plants that appeared to have a potential problem were selected. Results of the analyses indicate minimum critical flaw sizes small enough to be of concern before 32 EFPY. 24 refs., 16 figs., 7 tabs.

14781 **(EGG-M—32887) Controlling phenomena in PWR blackout sequences.** Plys, M.G.; Vanover, D.E.; Paik, C.Y.; Astleford, R.D.; Kenton, M.A.; Hammersley, R.J. (EG and G Idaho, Inc., Idaho Falls (USA); Fauske and Associates, Inc., Burr Ridge, IL (USA)). 1988. Contract AC07-76ID01570. 10p. (IAEA-SM—296/78; CONF-880309—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005284/JAW.

From International symposium on severe accidents in nuclear power plants IAEA - OECD/NEA; Sorrento, Italy (21 Mar 1988).

Phenomena which control accident sequence progression and fission product release are examined for a set of station blackout sequences for a large, dry containment design. Sensitivity to model assumptions, design provision, and physical parameters is exhibited through the choice of cases: loop seal clearing during safety valve cycling, operator depressurization of the primary system, cavity design to limit debris dispersal and allow flooding by available water, chemical activity coefficients, and concrete type. Results indicate that the distribution of core debris between the primary system and containment has a strong influence on fission product release from the debris. In general, the volume and design margin of large, dry containments allow substantial attentuation of airborne fission products during an accident. Consequently, if fission products are released during brief intervals such as during the period of in-vessel melting and during the aggressive period of concrete erosion, the long-term delay to containment failure ensures a limited ultimate release to the environment. However, when long-term in-vessel release occurs such as through revaporization of CsI in the primary system, release of Sr in overheated fuel remaining in the core, or release of Te during prolonged concrete erosion, releases to the environment are not well-attenuated and depend upon the strength and duration of the source. 6 refs., 2 figs., 3 tabs.

14782 **(EGG-M—88071) The influence of core degradation phenomena on in-vessel fission product behavior during severe accidents.** Hobbins, R.R.; Osetek, D.J.; Petti, D.A.; Hagrman, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 11p. (CONF-881014—19). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005433/JAW.

From International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety; Avignon, France (2 Oct 1988).

In-vessel core degradation phenomena influence where fission products will be located and in what chemical forms they will exist and with what materials they will be associated at the time the lower vessel fails in an unmitigated accident sequence. Fission products released from the reactor vessel during the in-vessel phase of core melt progression in a severe reactor accident can be deposited on reactor coolant system surfaces and be relatively unavailable for release to the containment, subject, however, to later revaporization. Fission products remaining in the fuel or sequestered in core debris can be available for release to the containment during ex-vessel processes such as high pressure melt ejection of core melt into the containment or during molten core-concrete interaction. This paper addresses the influence of several key in-vessel phenomena on fission product behavior and the availability of fission products for release to containment. Applicable results from the Severe Fuel Damage Test Series conducted in the Power Burst Facility and from the examination of the damaged core of the TMI-2 reactor have been discussed. 21 refs. , 2 figs., 1 tab.

14783 **(EGG-M—88185) Damaged TMI-2 core consolidated region crust behavior.** Kuan, P. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 30p. (CONF-881024—11). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005430/JAW.

From TMI-2 accident materials behavior, plant technology and recovery; Washington, DC, United States (30 Oct 1988).

This paper describes the thermal analyses that were performed in the study of the behavior of crusts around the consolidated region of the damaged TMI-2 core. The heat conduction equation was solved to determine: (1) the equilibrium thickness of the crucible-like lower crust during the initial stage of core damage, (2) the growth of the top crust as water was pumped through the core, and (3) the subsequent erosion of the lower and upper crusts by the enclosed molten material. The calculated minimum thickness of the lower crust (between 25 and 130 mm) compares well with the thickness of samples of the lower crust. The top crust was calculated to reach an equilibrium thickness of less than 20 mm at about 20 min after core cooling. The major core relocation at 224 min into the accident could have been initiated by the failure of such a thin top crust. 10 refs., 8 figs., 1 tab.

14784 (IA—1440, pp 263-265) **Radioactive fallout measurements in Israel, 1987.** Shamai, Y.; Dukhan, R.; Even, O.; Schlesinger, T. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

14785 (IA—1440, pp 32-34) **Simulation of a stuck-open-relief-valve event.** Gal, D.; Saphier, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

14786 (IA—1440, pp 36-37) **Verification of the DSNP hydraulic network solver.** Gal, D.; Saphier, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

14787 (IAEA-TC—560.02, pp 55-62) **Post-test analysis of the first IAEA PMK-NVH standard problem exercise.** Toth, I.; Perneczky, L.; Szabados, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The first PMK-NVH Standard Problem Exercise was organized by the IAEA with the aim to assist the activities relative to code assessment in the field of nuclear safety by comparison of code calculation with actual experimental data obtained from the PMK-NVH experimental facility. This paper presents post-test results obtained by the Central Research Institute for Physics with the RELAP4/MOD6 computer codes. Results are discussed by comparing pre- and post-test calculations with the experimental results. (author). 1 ref., 8 figs, 3 tabs.

14788 **(IAEA-TC—560.02) Computer aided safety analysis. Proceedings of a technical committee/workshop held in Warsaw, Poland, 25-29 May 1987.** (International Atomic Energy Agency, Vienna (Austria)). May 1988. 194p. (CONF-8705361—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW.

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The document reproduces 20 selected papers from the 38 papers presented at the Technical Committee/Workshop on Computer Aided Safety Analysis organized by the IAEA in co-operation with the Institute of Atomic Energy in Otwock-Swierk, Poland on 25-29 May 1987. A separate abstract was prepared for each of these 20 technical papers. Refs, figs and tabs.

14789 (IAEA-TC—560.02, pp 16-20) **Review of the Hungarian activity in the framework of the IAEA computer aided safety analysis.** Perneczky, L.; Szabados, L.; Toth, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The Hungarian activities under the IAEA Programme on Computer Aided Safety Analysis for the period 1985-1987 are presented. They are principally related to the calculation of the first PMK-NVH Standard Problem Exercise, however some calculations related to analysis of Paks nuclear power plant are also discussed. (author). 11 refs, 1 fig., 1 tab.

14790 (IAEA-TC—560.02, pp 20-25) **Polish participation in the IAEA regional programme on computer aided safety analysis.** Szczurek, J.; Kulig, M.; Kowalczyk, A. (Institute of Atomic Energy, Otwock-Swierk (Poland); Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The participation of the Institute of Atomic Energy and Central Laboratory for Radiological Protection in the IAEA Programme on Computer Aided Safety Analysis is presented and discussed under the light of the Polish Nuclear Programme and needs.

14791 (IAEA-TC—560.02, pp 34-55) **Advancements in the assessment of system codes used for safety analyses of nuclear power plants.** D'Auria, F.; Galassi, G.M.; Oriolo, F. (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

System codes are widely used to determine safety margins in NPPs. Unfortunately, uncertainties still exist in the evaluation of Nuclear Plants behaviour in case of accident. In this paper an outline is given concerning the present status of code assessment. In particular, two items are dealt with: importance of user on the results; procedure to quantify the limits of codes in the application to experimental data. (author). 31 refs, 29 figs, 4 tabs.

14792 (IAEA-TC—560.02, pp 62-71) **Post-test analysis of the PMK-NVH experiments by the codes RELAP4/MOD5 and SLAP2.** Bazso, Z.; Misak, J. (Nuclear Power Plants Research Inst., Trnava (Czechoslovakia)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

Post-test calculations of SB LOCA experiments are presented. The 7,4% SB LOCA on PMK-NVH integral at the experimental facility were analysed by computer codes RELAP4 and SLAP2, used in CSSR for nuclear safety analyses of PWRs. The calculations were performed on the EC 1045 computer at CRIP Budapest during an IAEA fellowship. (author). 4 refs, 10 figs, 1 tab.

14793 (IAEA-TC—560.02, pp 79-91) **Pre-test and post-test calculations performed by RELAP4/MOD6 code for the PMK-NVH standard problem Exercise-1.** Stefanova, S.; Sabotinov, L. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

This paper deals with the input preparation and presentation of pre-test and post-test results obtained at the IAEA computer centre on the IAEA Standard Problem Exercise-1 by using the RELAP4/MOD6 code. An intermediate size (7.4%) cold leg break loss of coolant experiment in the PMK-NVH facility at the Central Research Institute for Physics in Budapest without acting hydro-accumulators has been analysed. The pre-test and post-test calculations are compared with the experimental results and the reasons for the pre-test deviations from the experimental data are considered. A much better coincidence of the post-test results with the experiment has been achieved. The experience gained is discussed. (author). 6 refs, 20 figs, 6 tabs.

14794 (IAEA-TC—560.02, pp 91-110) **ENEL applications of TRAC1PLT code to PMK-NVH standard problem exercise.** Bella, L.; Marinov, M. (ENEL, Pisa (Italy). Direzione Studi e Ricerche). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The present report documents the latest PMK-NVH 7.4% cold leg small break analysis, that is the base of the 1st IAEA Standard Problem Exercise, performed from ENEL by the Nuclear Safety Area of Thermal and Nuclear Research Center (CRTN) at Pisa. The calculated transient was carried out using TRAC1PLT, that is an ENEL version of TRACP1A computer code, the obtained results together with previous RELAP4/MOD6 and PMK-NVH experimental data are compared. After a summary PMK-NVH experiment test transient description an overall scenario of the models and principal options of TRAC1PLT and RELAP4/MOD6 models used are presented. A TRAC1PLT nodalization problems discussion follows. In the last part of the report a comparison between analytical and experimental results is carried out with a special emphasis on the capabilities of the two computer codes. Finally the conclusion and the recommendation for this type of transient analysis is carried out. (author). 11 refs, 22 figs, 2 tabs.

14795 (IAEA-TC—560.02, pp 111-125) **Austrian post-test analysis for the first IAEA standard problem exercise.** Pfau, H.; Sonneck, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Reaktorsicherheit). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

This paper presents results of post-test calculations relative to the first PMK-NVH Standard Problem Exercise, performed with RELAP4/MOD6 code utilizing a quite simple nodalization scheme. Influence of different modelling options on final results are discussed in some detail. (author). 5 refs, 19 figs.

14796 (IAEA-TC—560.02, pp 125-131) **Selections of models and options in RELAP4/MOD6 code.** Perneczky, L.; Toth, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The selection of facility model and code options have been recognized as influencing strongly the results of calculations of accident analysis with large complex computer codes. This paper discusses the influences of models and options during RELAP4/MOD6 calculations of large and small breaks. Plant analysis and standard problem exercises are taken into consideration. (author). 13 refs, 4 figs.

14797 (IAEA-TC—560.02, pp 135-140) **Analysis of the influence of the steam generator tube plugging on large-break loss-of-coolant accident at Krsko nuclear power plant.** Stritar, A.; Bizjak, S.; Gregoric, M.; Mavko, B. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

A preliminary analysis of the steam generator tube plugging effects to the large-break LOCA behaviour of the Krsko NPP was performed. At 10% tube plugging, the peak cladding temperature is 37 K higher compared to the LOCA without it. A decrease of the maximum peaking factor from 2.34 to 2.25 would compensate the influence of 10% plugged tubes. The present analysis was not fully in compliance with the requirements for the conservative methodology in which case the temperature difference and, consequently, the necessary decrease of the maximum peaking factor, would be even greater. (author). 8 refs, 7 figs.

14798 (IAEA-TC—560.02, pp 141-148) **First adaptations and completions of the SSYST code for analysing WWER type fuel rods.** Linek, J.; Reinfried, D. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The SSYST code is a modular computer code developed at Karlsruhe Nuclear Research Centre (KFK) for modelling light water reactor fuel rods. This paper describes the experiences in modelling WWER type fuel rods with SSYST at the Institute of Nuclear Research Rossendorf. Problems of coupling SSYST code with STOFFEL-1, a fuel performance modelling code, are also discussed. (author). 4 refs, 4 figs, 1 tab.

14799 (IAEA-TC—560.02, pp 149-154) **Loviisa Unit 2 overcooling transient calculation using the computer code RELAP5/MOD1.** Vuorio, P.; Tuomisto, H.; Kantee, H. (Imatran Voima Oy, Helsinki (Finland)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The thermal-hydraulic system code RELAP5/MOD1 currently used in Imatran Voima, Finland, has been used in the analysis of the transient at the Loviisa Unit 2. The overcooling event was initiated by a reactor trip and by an associated stuck-open turbine by-pass valve. The downcomer temperature decreased from 265 deg. C to 215 deg. C in fifteen minutes and high-pressure safety injection was actvated. The plant transient data have been valuable when thermal-hydraulic methods have been assessed for applications in Loviisa safety analyses. (author). 2 refs, 11 figs, 2 tabs.

14800 (IAEA-TC—560.02, pp 155-160) **Analysis of turbine trip for Krsko nuclear power plant after SG tube plugging using ALMOD3W2.** Debrecin, N.; Feretic, D.; Cavlina, N. (Zagreb Univ. (Yugoslavia). Elektrotehnicki Fakultet). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

In the last few years about 3% steam generator tubes were plugged at NPP Krsko. Due to tube plugging RCS flow was reduced, and also other plant parameters at 100% power were changed. For NPP Krsko one question is very important from the safety point of view: how many tubes may be plugged before the power reduction is needed. To answer this question it is required to perform or evaluate the events of Chapter 15 of NPP Krsko Final Safety Analysis Report. In this article turbine trip is analysed after 5% and 10% SG tubes were plugged. The analysis is performed using ALMOD3W2 code. (author). 4 refs, 3 figs.

14801 (IAEA-TC—560.02, pp 160-177) **Plant transient analysis at the PMK-NVH: Total loss of flow test.** Szabados, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

A loss of flow transient test was conducted at the PMK-NVH integral test facility. This paper describes the test conditions and presents some of the experimental results. Comparison between experiments and analytical results obtained with RELAP4/MOD6 are also discussed. (author). 4 refs, figs and tabs.

14802 (IAEA-TC—560.02, pp 178-181) **Adjustments in ALMOD3W2 transient analysis code to fit ANGRA 1 nuclear power plant experimental data.** Madeira, A.A.; Camargo, C.T.M. (Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

Some small modifications were introduced in ALMOD3W2 code, a consequence of the interest in reproducing the full load rejection test in Angra 1 NPP. Such modifications showed to be adequate when code results were compared with experimental data. (author). 4 refs, 2 figs.

14803 (IAEA-TC—560.02, pp 181-189) **State of the art of computer codes and experimental programs for the safety of nuclear power plants with WWER type reactors.** Asmolov, V.G.; Volkov, G.A.; Elkin, I.V.; Mysenkov, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). May 1988. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The computerized simulations of the accident and abnormal conditions at nuclear power plants are very important tools for its safety assessment. This presentation is a survey of computer codes used in the USSR for safety analysis of WWER type reactors. It also presents a review of the experimental facilities for safety experiments in the field. The plans in safety analysis programs for today and the future are presented.

14804 (IAEA-TC—560.02, pp 26-34) **Aspects of code assessment.** Holmstroem, H.; Yrjoelae, V. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

The final goal of the assessment of a computer code is a judgment about the accuracy with which it can be used to calculate the behaviour of real full size power plants in various accident and transient situations. The so called standard problems may form a part of an assessment effort, but alone they are not enough. Also assessment performed by others is not enough, especially, if the results (assessment reports) are not available. In fact, every user should perform several assessment calculations, if not for any other reason, for training and assessing himself in the use of the code. Otherwise his calculations cannot be relied on. The objective of this paper is to promote discussion on the role of assessment and the various suggested assessment methodologies, which are presented together with their associated problems. (author). 5 figs.

14805 (INIS-XN—147) **Emergency planning practices and criteria in the OECD countries after the Chernobyl accident. A critical review.** Boeri, G.; Wiktorsson, C. (Nuclear Energy Agency, 75 - Paris (France)). Sep 1988. 159p. NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88705381/JAW.

This critical review has been prepared at the request of the Committee on Radiation Protection and Public Health (CRPPH), on the basis of information collected from Member countries on their emergency planning practices and criteria, and on changes being considered as a consequence of the Chernobyl accident. This information was officially provided to the Secretariat in response to a questionnaire. Other material has also been used, such as official papers describing national practices and reports presented at meetings organised by the NEA. In these cases the sources are given in the list of references. The information in this report reflects the situation in the Member countries at the end of 1987 and it might well be that additional changes were introduced in the emergency planning practices and criteria of several countries after the answers were sent to the Secretariat. It should also be noted that several of the questions were mainly relevant to nuclear power reactor operations. However, the basic philosophy for emergency planning is general, i.e. radiological criteria, emergency organisation, medical assistance, information to the public, etc., and applies in similar ways to different emergencies. Therefore, the information in the report should be valid for different types of radiological emergencies, although emphasis is placed in the report is on nuclear power reactor emergencies. For non-nuclear power Member countries the information refers mainly to plans to cope with other types of radiation emergencies, and to emergencies of a transboundary origin. Finally, the information covers only the off-site part of emergency planning, apart from some reflections in Chapter 1 on on-site emergency planning and the measures taken at nuclear facilities to prevent an accident or mitigate its consequences.

14806 (INIS-XN—149, pp 143-174) **Status of achievements reached in applying optimisation of protection in prevention and mitigation of accidents in nuclear facilities.** Bengtsson, G.; Hoegberg, L. (Swedish National Institute of Radiation Protection Stockholm (Sweden); Swedish Nuclear Power Inspectorate, Stockholm (Sweden)). 1988. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW. (CONF-8803179—).

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

Optimisation of protection in a broad sense is basically a political undertaking, where the resources put into protection are balanced against other factors - quantifiable and non-quantifiable - to obtain the best protection that can be achieved under the circumstances. In a narrower sense, optimisation can be evaluated in procedures allowing for a few quantifiable factors, such as cost/effectiveness analysis. These procedures are used as inputs to the broader optimisation. The paper discusses several examples from Sweden concerning evaluations and decisions relating to prevention of accidents and mitigation of their consequences. Comparison is made with typical optimisation criteria proposed for radiation protection work and for cost/effective analysis in the USA, notably NUREG-1150 (draft). The examples show that optimisation procedures in a narrower sense have not been decisive. Individual dose limits seem to be increasingly important as compared to collective dose optimisation, and political, commercial or engineering judgements may lead to decisions far away from those suggested by simple optimisation considerations.

14807 **(NUREG—0781-Suppl.6) Safety Evaluation Report related to the operation of South Texas Project, Unit 2 (Docket No. 50-499).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jan 1989. 159p. NTIS, PC A08/MF A01 - GPO - OSTI. Order Number TI89006289/JAW.

In April 1986 the staff of the US Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-0781) regarding the application of Houston Lighting and Power Company (applicant and agent for the owners) for a license to operate South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499). The facility is located in Matagorda County, Texas, west of the Colorado River, 8 miles north-northwest of the town of Matagorda and about 89 miles southwest of Houston. The first supplement to NUREG-0781 was issued in September 1986, the second supplement in January 1987, the third supplement in May 1987, the fourth supplement in July 1987 and the fifth supplement in March 1988. This sixth supplement provides updated information on the issues that had been considered previously as well as the evaluation of issues that have arisen since the fifth supplement was issued. The evaluation resolves all the issues necessary to support the issuance of a low-power license for Unit 2.

14808 **(NUREG—1230) Compendium of ECCS [Emergency Core Cooling Systems] research for realistic LOCA [loss-of-coolant accidents] analysis: Final report.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research). Dec 1988. 1364p. NTIS, PC A99/MF A01 - GPO - OSTI. Order Number TI89007027/JAW.

In the United States, Emergency Core Cooling Systems (ECCS) are required for light water reactors (LWRs) to provide cooling of the reactor core in the event of a break or leak in the reactor piping or an inadvertent opening of a valve. These accidents are called loss-of-coolant accidents (LOCA), and they range from small leaks up to a postulated full break of the largest pipe in the reactor cooling system. Federal government regulations provide that LOCA analysis be performed to show that the ECCS will maintain fuel rod cladding temperatures, cladding oxidation, and hydrogen production within certain limits. The NRC and others have completed a large body of research which investigated fuel rod behavior and LOCA/ECCS performance. It is now possible to make a realistic estimate of the ECCS performance during a LOCA and to quantify the uncertainty of this calculation. The purpose of this report is to summarize this research and to serve as a general reference for the extensive research effort that has been performed. The report: (1) summarizes the understanding of LOCA phenomena in 1974; (2) reviews experimental and analytical programs developed to address the phenomena; (3) describes the best-estimate computer codes developed by the NRC; (4) discusses the salient technical aspects of the physical phenomena and our current understanding of them; (5) discusses probabilistic risk assessment results and perspectives, and (6) evaluates the impact of research results on the ECCS regulations. 736 refs., 412 figs., 66 tabs.

14809 **(NUREG—1319) A prioritization of research activities.** Pittman, J.W. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Dec 1988. 105p. NTIS, PC A06/MF A01 - GPO - OSTI. Order Number TI89006229/JAW.

This report presents the results of the efforts in prioritizing the activities in the Office of Research. The purpose of this prioritization is to provide a basis on which to make management decisions. The report describes also the methodology and criteria upon which the priority rankings are based. Each activity was evaluated against four attributes. These attributes are: safety assurance, usefulness, appropriateness and resources. This report will be periodically revised to include the prioritization of new activities, deletion of completed activities and to reflect changes in budget allocations and projections. 3 refs., 5 figs.

14810 **(NUREG—1336) Interim guidance on the standard format and content of financial assurance mechanisms required for decommissioning under 10 CFR Parts 30, 40, and 70.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning). Dec 1988. 124p. NTIS, PC A06/MF A01 - GPO - OSTI. Order Number TI89005990/JAW.

Interim Guidance on the Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning under 10 CFR Parts 30, 40, and 70, NUREG-1336, discusses the information to be provided in a license application and established a uniform format for presenting the information required to meet the decommissioning licensing requirements. The use of the Standard Format will (1) help ensure that the license application contains the information required by the regulations, (2) aid the applicant in ensuring that the information is complete, (3) help persons reading the Standard Format to locate information, and (4) contribute to shortening the time required for the review process. The Standard Format and Content (NUREG-1336) ensures that the information required to perform the review is provided, and in a useable format.

14811 **(NUREG—1337) Interim guidance on the Standard Review Plan for the review of financial assurance mechanisms for decommissioning under 10 CFR Parts 30, 40, and 70.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning). Dec 1988. 34p. NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89005989/JAW.

Interim Guidance on the Standard Review Plan (SRP) for the Review of Financial Assurance Mechanisms for Decommissioning under 10 CFR Parts 30, 40, and 70 is prepared for the guidance of Nuclear Regulatory Commission staff reviewers in performing reviews of applications from material licensees affected by the decommissioning regulations established June 27, 1988 (53FR24018). The principal purpose of the SRP is to assure the quality and uniformity of staff reviews and to present a base from which to evaluate the financial assurance aspects of the applications. NUREG-1337, identifies who performs the review, the matters that are reviewed, the basis of the review, how the review is performed, and the conclusions that are sought. 3 refs.

14812 **(NUREG/CP—0095) Fourth workshop on containment integrity: Proceedings.** Cochrell, R. (ed.). (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Standards; Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. 656p. (SAND—88-1836; CONF-880616—). NTIS, PC A99/MF A01 - GPO - OSTI. Order Number TI89004641/JAW.

From 4. workshop on integrity of containments for nuclear power plants; Arlington, VA, USA (14 Jun 1988).

The Fourth Workshop on Containment Integrity was held in Arlington, Virginia, on June 14--17, 1988. The workshop provided a forum for exchanging information on the integrity of containments at nuclear power plants. The behavior of containments during severe accidents was of primary interest to the participants. Major topics included: containment integrity/performance; containment loading conditions during severe accidents; seismic response of containments: experimental studies of containment; analyses associated with the Sandia 1:6 scale model test; analytical studies of containment; and severe accident mitigation.

14813 **(NUREG/CR—2331-Vol.7-No.4) Safety research programs sponsored by Office of Nuclear Regulatory Research: Progress report, October 1--December 31, 1987.** Weiss, A.J. (comp.); Bari, R.A.; Boccio, J.L.; Fitzpatrick, R.; Ginsberg, T.; Greene, G.A.; Guppy, J.G.; Hall, R.E.; Higgins, J.C.; Khatib-Rahbar, M. (Nuclear Regulatory Commission, Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA)). Aug 1988. Contract AC02-76CH00016. 119p. (BNL-NUREG—51454-Vol.7-No.4). NTIS, PC A07/MF A01 - GPO - OSTI. Order Number TI89006105/JAW.

The Advanced Reactor Review Safety Research Program has continued under NRC Research funding since October 1986. In April 1987, as a result of an NRC reorganization, the Accident Analysis and Safety Review of Liquid Metal and High Temperature Gas Reactors (LMRs and HTGRs) Program was transferred from Regulation to Research. Both programs are discussed here under the title of Accident Analysis and Safety Review of Liquid Metal and High Temperature Gas Reactors (LMRs and HTGRs). The combined programs are focused to help NRC accomplish the review of advanced reactor (LMR and HTGR) designs over the next year. Technical assistance in the following areas is provided: (1) review, adaptation, and implementation of analytical tools and models for application to the design submittals, (2) independent analysis of specific accidents and plant conditions and characteristics for the designs, (3) developing and evaluating appropriate source terms, (4) reviewing DOE reports on safety issues, (5) review of those aspects of DOE's base technical program related to the areas described in (1) through (4), and (6) assistance in assessing PRAs submitted for review.

14814 **(NUREG/CR—4618) Evaluation of reliability technology applicable to LWR operational safety.** Azarm, M.A.; Lofgren, E.V.; Boccio, J.L.; Carbonaro, J.; Dougherty, E.; Fragola, J.R.; Hall, R.E.; Ruger, C.; Vesely, W.E. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA)). Aug 1988. Contract AC02-76CH00016. 248p. (BNL-NUREG—51995). NTIS, PC A11/MF A01 - GPO - OSTI. Order Number TI89006111/JAW.

This report describes work performed mostly in FY 1986 to identify the tasks and technology of an operational reliability program that can help to maintain the safety of operating nuclear power plants. The structure and tasks of a reliability program to accomplish this role are presented, along with reliability technology that might be used to perform or implement each task. The bulk of the report, however, summarizes technical work accomplished to verify that reliability programs are feasible and practical. 24 refs., 16 figs., 11 tabs.

14815 **(NUREG/CR—4780-Vol.2) Procedures for treating common cause failures in safety and reliability studies: Analytical background and techniques.** Mosleh, A.; Fleming, K.N.; Parry, G.W.; Paula, H.M.; Worledge, D.H.; Rasmuson, D.M. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Electric Power Research Inst., Palo Alto, CA (USA); Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA)). Jan 1989. 130p. (EPRI-NP—5613-Vol.2; PLG—0547-Vol.2). NTIS, PC A07/MF A01 - GPO - OSTI. Order Number TI89006721/JAW.

Volume I of this report presents a framework for the inclusion of the impact of common cause failures in risk and reliability evaluations. Common cause failures are defined as that subset of dependent failures for which causes are not explicitly included in the logic model as basic events. The emphasis here is on providing procedures for a practical, systematic approach that can be used to perform and clearly document the analysis. The framework and the methods discussed for performing the different stages of the analysis integrate insights obtained from engineering assessments of the system and the historical evidence from multiple failure events into a systematic, reproducible, and defensible analysis. This document, Volume 2, contains a series of appendices that provide additional background and methodological detail on several important topics discussed in Volume I.

14816 **(NUREG/CR—4835) Comparison and application of quantitative human reliability analysis methods for the risk methods integration and evaluation program (RMIEP): Final report.** Haney, L.N.; Blackman, H.S.; Bell, B.J.; Rose, S.E.; Hesse, D.J.; Minton, L.A.; Jenkins, J.P. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; EG and G Idaho, Inc., Idaho Falls (USA); Battelle Columbus Div., OH (USA)). Jan 1989. Contract AC07-76ID01570. 191p. (EGG—2485; BMI—2159). NTIS, PC A09/MF A01 - GPO - OSTI. Order Number TI89006045/JAW.

This report documents a comparison of human reliability analysis (HRA) techniques using data that resulted from the Risk Methods Integration and Evaluation Program (RMIEP) sponsored by the US Nuclear Regulatory Commission. A literature search identified 20 HRA methods for consideration. Twelve methods were evaluated as appropriate for use in probabilistic risk assessment (PRA) for nuclear power plants (NPPs) by using a criteria set developed for that purpose. Data were collected at a commercial NPP with operators responding to walkthroughs of four severe accident scenarios. An HRA systems analysis was also performed for the plant. The data were used in the application and quantitative comparison of selected HRA methods. Qualitative comparisons of the 12 methods are provided via attribute descriptions and ratings of their utility in an HRA selection tool designed to help analysts select appropriate HRA methods based on their goals and available resources. An assessment of the current state of the art of HRA for PRA is presented as well as recommendations for the future use of HRA in PRA.

14817 **(NUREG/CR—5039-Vol.2) Reactor safety research semiannual report, July--December 1987: Reactor Safety Research Program.** Walker, J.V. (ed.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 317p. (SAND—87-2411-Vol.2). NTIS, PC A15/MF A01 - GPO - OSTI. Order Number TI89004851/JAW.

Sandia National Laboratories is conducting under USNRC sponsorship, phenomenological research related to the safety of commercial nuclear power reactors. The research includes experiments to simulate the phenomenology of accident conditions and the development of analytical models, verified by experiment, which can be used to predict reactor and safety systems performance behavior under abnormal conditions. The objective of this work is to provide NRC requisite data bases and analytical methods to (1) identify and define safety issues, (2) understand the progression of risk- significant accident sequences, and (3) conduct safety assessments. The collective NRC-sponsored effort at Sandia National Laboratories is directed at enhancing the technology base supporting licensing decisions. 94 refs., 129 figs., 39 tabs.

14818 **(NUREG/CR—5069) TRAC-PF1/MOD1 correlations and models.** Liles, D.R.; Spore, J.W.; Knight, T.D.; Nelson, R.A.; Cappiello, M.W.; Pasamehmetoglu, K.O.; Mahaffy, J.H.; Guffee, L.A.; Stumpf, H.J.; Dotson, P.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis; Los Alamos National Lab., NM (USA)). Dec 1988. Contract W-7405-ENG-36. 559p. (LA—11208-MS). NTIS, PC A24/MF A01 - GPO - OSTI. Order Number TI89005993/JAW.

The Los Alamos National Laboratory is developing the Transient Reactor Analysis Code (TRAC) to provide advanced best-estimate simulations of real and postulated transients in pressurized light-water reactors and for many related thermal-hydraulic facilities. The TRAC-PF1/MOD1 program is the latest released version. The code features a one- and/or three-dimensional, two-fluid treatment for the thermal hydraulics, together with other necessary modeling capabilities to describe a reactor system. This report complements the TRAC-PF1/MOD1 code manual and provides much more detailed descriptions of the various correlations and models utilized by the code. These correlations and models in general provide the necessary closure relations required by the field equations and also provide additional models necessary for the transient simulations. The report is primarily an audit, or a detailed description, of the correlations and models as represented in the code. The report also provides the basis for each through references to original literature and/or a description of the development process; lists the assumptions made in the implementation, including the definitions of required parameters not normally calculated by the code; and describes other details of the implementation. A partial assessment has been provided of some of the more important, less well-founded correlations and models to indicate the inherent accuracy, although it is believed that a true measure of overall code accuracy must include assessment of the code against integral experiment data because of synergistic effects.

14819 **(NUREG/CR—5088) Fire Risk Scoping Study: Investigation of nuclear power plant fire risk, including previously unaddressed issues.** Lambright, J.A.; Nowlen, S.P.; Nicolette, V.F.; Bohn, M.P. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 422p. (SAND—88-0177). NTIS, PC A18/MF A01 - GPO - OSTI. Order Number TI89006830/JAW.

An investigation of nuclear power plant fire risk issues raised as a result of the USNRC sponsored Fire Protection Research Program at Sandia National Laboratories has been performed. The specific objectives of this study were (1) to review and requantify fire risk scenarios from four fire probabilistic risk assessments (PRAs) in light of updated data bases made available as a result of USNRC sponsored Fire Protection Research Program and updated computer fire modeling capabilities, (2) to identify potentially significant fire risk issues that have not been previously addressed in a fire risk context and to quantify the potential impact of those identified fire risk issues where possible, and (3) to review current fire regulations and plant implementation practices for relevance to the identified unaddressed fire risk issues. In performance of the fire risk scenario requantifications several important insights were gained. It was found that utilization of a more extensive operational experience base resulted in both fire occurrence frequencies and fire duration times (i.e., time required for fire suppression) increasing significantly over those assumed in the original works. Additionally, some thermal damage threshold limits assumed in the original works were identified as being nonconservative based on more recent experimental data. Finally, application of the COMPBRN III fire growth model resulted in calculation of considerably longer fire damage times than those calculated in the original works using COMPBRN I. 14 refs., 2 figs., 16 tabs.

14820 **(NUREG/CR—5176) Seismic failure and cask drop analyses of the spent fuel pools at two representative nuclear power plants.** Prassinos, P.G.; Kimura, C.Y.; McCallen, D.B.; Murray, R.C.; Ravindra, M.K.; Campbell, R.D.; Hashimoto, P.S.; Nafday, A.M.; Tong, W.H. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 166p. (UCID—21425). NTIS, PC A08/MF A01 - GPO - OSTI. Order Number TI89006432/JAW.

This report discusses work done in support of the resolution of Generic Issue-82, "Beyond Design Basis Accidents in Spent Fuel Pools". Specifically the probability of spent fuel pool failure due to earthquakes was determined for the pools at the Vermont Yankee Nuclear Power Station (BWR) and the H. B. Robinson S.E. Plant, Unit 2 (PWR). The dominant failure mode for each pool was gross structural failure caused by seismic motion resulting in the loss of pool liner integrity. The resulting sudden loss of water was then assumed to lead to a self-propagating cladding failure and fission product inventory release from the spent fuel elements in the pool. The mean annual frequency of failure due to this failure mode was found to be 6.7E-06 at Vermont Yankee and 1.8E-06 at H. B. Robinson. Other earthquake induced failure modes studied but found to be less important were loss of pool cooling and make-up capability, fuel rack damage and loss of liner integrity due to a cask drop accident. 61 refs., 47 figs., 14 tabs.

14821 **(NUREG/CR—5186) Value/impact analysis of Generic Issue 94, {open←quotes}Additional Low Temperature Overpressure Protection for Light Water Reactors{close←quotes}.** Gore, B.F.; Vo, T.V.; Colburn, A.J.; Eschbach, E.J.; Harris, M.S. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. 171p. (PNL—6589). NTIS, PC A08/MF A01 - GPO - OSTI. Order Number TI89006324/JAW.

This document presents a value/impact analysis of the expected risk reduction and associated costs for seven regulatory alternatives which have been proposed to resolve the generic issue of low temperature overpressure (LTOP) transients. It also presents an analysis of the reduction of public risk which was accomplished by the 1979 imposition of requirements for LTOP transient protection, when LTOP had previously been designated as a generic issue. The alternatives evaluated were: no action, prohibit operations with the reactor cooling system (RCS) "water solid" except when it is depressurized and vented, and require all operating reactors to maintain a bubble of steam or noncondensible gas (N_2) in the pressurizer when the RCS is not vented; prohibit operation of the RCS in a water-solid condition when either train of the overpressure mitigation system (OMS) is out of service; prohibit operation with the RCS in a water-solid condition when a high pressure safety injection pump is in service; prohibit restart of a reactor coolant pump when the RCS is in a water-solid condition; require that the pressure setpoint for automatic isolation of the residual heat removal system be raised above the setpoint for residual heat removal safety relief valve opening to maintain this relief path as backup to the OMS; and require the OMS to be safety grade. The risk analysis of each alternative estimated the public risk from the operation of the 63 presently operating pressurized water reactors summed over the period from the present to end of licensing. 20 refs., 7 figs., 45 tabs.

14822 **(NUREG/CR—5197) Evaluation of generic issue 115: Enhancement of the reliability of Westinghouse Solid State Protection System.** Reny, D.A.; Bruske, S.J.; Valenti, L.N.; Davis, M.L.; Gregg, R.E. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1989. Contract AC07-76ID01570. 131p. (EGG—2456). NTIS, PC A07/MF A01 - GPO - OSTI. Order Number TI89006474/JAW.

This report presents the evaluation of the potential safety concerns identified in Generic Issue 115, Enhancement of the Reliability of the Westinghouse Solid State Protection System. The reliability of the Westinghouse (W) Solid State Protection System (SSPS) was evaluated to analyze the frequency of anticipated transient without scram (ATWS) events for W reactors that use the SSPS. The analysis evaluated the current (base case) W SSPS configuration reliability to trip the reactor on demand. The base case reactor trip reliability was used in a generic W ATWS event tree and evaluated for frequency of core damage. Several options for improving the base case design of the reactor trip system were identified and evaluated for their effect on the core damage frequency. A consequence analysis, cost analysis, and cost/benefit analysis were performed and results are presented for each option. 32 refs., 12 figs., 18 tabs.

14823 **(NUREG/CR—5228-Vol.1) Techniques for preparing flowchart-format emergency operating procedures: Background (Sections 1.0-9.0).** Barnes, V.E.; Moore, C.J.; Wieringa, D.R.; Isakson, C.S.; Kono, B.K.; Gruel, R.L. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation; Battelle Human Affairs Research Center, Seattle, WA (USA); Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 195p. (PNL—6653-Vol.1; BHARC—700/88/017-Vol.1). NTIS, PC A09/MF A01 - GPO - OSTI. Order Number TI89006762/JAW.

This two-volume report describes the activities, findings, and recommendations of a project entitled "Techniques for Presenting Flowchart-Format Emergency Operating Procedures." The project team surveyed the literature pertaining to flowcharts, reviewed existing flowchart emergency operating procedures (EOPs), interviewed consultants who produced flowcharts, and interviewed reactor operator licensing examiners about the use of flowcharts in nuclear power plants. This document, and Volume 1 of this report, discusses the use of flowchart-format EOPs in nuclear power plants and presents issue to be addressed in the design and implementation of flowchart EOPs. 66 refs., 76 figs., 2 tabs.

14824 **(NUREG/CR—5228-Vol.2) Techniques for preparing flowchart-format emergency operating procedures: User's manual (Sections 10.0--17.0).** Barnes, V.E.; Moore, C.J.; Wieringa, D.R.; Isakson, C.S.; Kono, B.K.; Gruel, R.L. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation; Battelle Human Affairs Research Center, Seattle, WA (USA); Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 88p. (PNL—6653-Vol.2; BHARC—700/88/017-Vol.2). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89006763/JAW.

This two-volume report describes the activities, findings, and recommendations of a project entitled "Techniques for Presenting Flowchart-Format Emergency Operating Procedures." The project team surveyed the literature pertaining to flowcharts, reviewed existing flowchart emergency operating procedures (EOPs), interviewed consultants who produced flowcharts, and interviewed reactor operator licensing examiners about the use of flowcharts in nuclear power plants. This document, Volume 2, presents techniques for preparing flowchart EOPs that were derived from the information discussed in Volume 1 and from NUREG-0899, Guidelines for the Preparation of Emergency Operating Procedures (USNRC, 1982). 38 figs.

14825 **(NUREG/CR—5245) A review of the Crystal River Unit 3 Probabilistic Risk Assessment: Internal events, core damage frequency.** Hanan, N.A.; Henley, D.R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Argonne National Lab., IL (USA)). Jan 1989. Contract W-31109-ENG-38. 190p. (ANL—88-40). NTIS, PC A09/MF A01 - GPO - OSTI. Order Number TI89006761/JAW.

A review of the Crystal River Unit 3 Probabilistic Risk Assessment (CR-3 PRA) was performed with the objective of evaluating the dominant accident sequences and major contributions to the core damage frequency from internally-generated initiators. This review included not only an assessment of the assumption and methods used in the CR-3 PRA, but also included a quantitative analysis of the accident initiators, and accident sequences resulting in core damage. The effects of data uncertainties on the core damage frequency were quantified and sensitivity analysis was also performed. 55 refs., 22 figs., 30 tabs.

14826 **(NUREG/CR—5264) Guide for licensing evaluations using CRAC2: A computer program for calculating reactor accident consequences.** White, J.E.; Roussin, R.W.; Gilpin, H. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Information Support Services; Oak Ridge National Lab., TN (USA)). Dec 1988. Contract AC05-84OR21400. 176p. (ORNL/TDMC—3). NTIS, PC A09 - GPO - OSTI. Order Number TI89006288/JAW.

A version of the CRAC2 computer code applicable for use in analyses of consequences and risks of reactor accidents in case work for environmental statements has been implemented for use on the Nuclear Regulatory Commission Data General MV/8000 computer system. Input preparation is facilitated through the use of an interactive computer program which operates on an IBM personal computer. The resulting CRAC2 input deck is transmitted to the MV/8000 by using an error-free file transfer mechanism. To facilitate the use of CRAC2 at NRC, relevant background material on input requirements and model descriptions has been extracted from four reports - "Calculations of Reactor Accident Consequences," Version 2, NUREG/CR-2326 (SAND81-1994) and "CRAC2 Model Descriptions," NUREG/CR-2552 (SAND82-0342), "CRAC Calculations for Accident Sections of Environmental Statements," NUREG/CR-2901 (SAND82-1693), and "Sensitivity and Uncertainty Studies of the CRAC2 Computer Code," NUREG/CR-4038 (ORNL-6114). When this background information is combined with instructions on the input processor, this report provides a self-contained guide for preparing CRAC2 input data with a specific orientation toward applications on the MV/8000. 8 refs., 11 figs., 10 tabs.

14827 **(NUREG/CR—5278) Cost analysis for potential BWR Mark 1 containment improvements.** Claiborne, E.; Simion, G.; Knudson, R.; Sciacca, F.; Riordan, B.; Godfrey, P.; Cohen, S. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Science and Engineering Associates, Inc., Albuquerque, NM (USA)). Jan 1989. 65p. (SEA—87-253-07-A-1). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89006407/JAW.

The Nuclear Regulatory Commission (NRC) has identified several potential improvements to BWRs with Mark 1 containments. The Mark 1 containments have been chosen for this initial effort because they appear to have a relatively high conditional probability of failure for severe accidents. This study is a cost analysis of three potential areas of Mark 1 containment improvement. Considered were: Automatic Depressurization System (ADS) enhancements; back-up water supply enhancements; and wetwell venting enhancements. These cost analyses are comprehensive. In addition to the costs of physical modifications, they also include aspects such as engineering and quality assurance, radiation exposure, health physics support, and anti-contamination clothing. Also considered are licensee costs associated with technical specification changes, writing or rewriting operating procedures, and staff training. The analyses show that the industry costs per reactor for installation of all improvements range from about $1.6 million for the low cost options to $3.15 million for the high cost options. In addition, these physical modifications are estimated to result in occupational radiation exposures ranging from about 20 person-rem to 150 person-rem per reactor. 7 refs., 5 figs., 1 tab.

14828 **(SAND—88-7010) The CONTAIN code severe accident confinement analysis for the N-Reactor: Phase 1 and 2.** Tills, J.L. (Sandia National Labs., Albuquerque, NM (USA); Tills (Jack) and Associates, Inc., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 159p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004426/JAW.

The Nuclear Regulatory Commission's integrated containment analysis code, CONTAIN, has been adapted to perform confinement analysis of the N-Reactor. In the first phase of adaptation, flow path logic updates were generated and included in the CONTAIN code in order to handle the complex venting scheme of the confinement system. The modified code was applied to a hydraulic analysis of a hypothetical accident sequence, and the results were compared to previous calculations that had been completed with the HECTR code. In the second phase, fission product transport was invoked in the CONTAIN input deck to allow tracking of noble gas isotopes, molecular iodine isotopes, and inert aerosols. The interaction of sprays with suspended fission products was compared to earlier results given in the N-Reactor Updated Safety Analysis report. Finally, recommendations were given for new model development that would be beneficial to future analysis of the N-Reactor using CONTAIN. 8 refs., 32 figs., 8 tabs.

14829 **(SAND—89-0029C) An overview of the fire risk scoping study.** Nowlen, S.P.; Lambright, J.A.; Nicolette, V.F., Bohn, M.P. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 8p. (CONF-890256—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005776/JAW.

From Electrical Power Research Institute fire safety workshop; Baltimore, MD, USA (8 Feb 1989).

The fire risk scoping study was sponsored by the US Nuclear Regulatory Commission and performed at Sandia National Laboratories. The study was initiated as a result of previous USNRC-sponsored fire research efforts that had identified certain fire risk issues that had not been addressed in previously completed commercial nuclear power plant fire risk analyses. The specific objectives of this study were: (1) to review and requantify fire risk scenarios from four fire probabilistic risk assessments in light of updated data bases made available as a result of USNRC-sponsored Fire Protection Research Program and updated computer fire modeling capabilities, (2) to identify potentially significant fire risk issues that have not been previously addressed in a fire risk context and to quantify the potential impact of those identified fire risk issues where possible, and (3) to review current fire regulations and plant implementation practices for relevance to the identified unaddressed fire risk issues. 9 refs., 3 tabs.

14830 **(NUREG/CR—2331-Vol.8-Nos.1,2) Safety research programs sponsored by Office of Nuclear Regulatory Research: Progress report, January 1--June 30, 1988.** Baum, J.W.; Boccio, J.L.; Diamond, D.; Fitzpatrick, R.; Ginsberg, T.; Greene, G.A.; Guppy, J.G.; Hall, R.E.; Higgins, J.C.; Weiss, A.J. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA)). Dec 1988. Contract AC02-76CH00016. 255p. (BNL-NUREG—51454-Vol.8-Nos.1,2). NTIS, PC A12/MF A01 - GPO - OSTI. Order Number TI89005762/JAW.

This progress report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the Division of Regulatory Applications, Division of Engineering, Division of Safety Issue Resolution, and Division of Systems Research of the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research following the reorganization in July 1988. The previous reports have covered the period October 1, 1976 through December 31, 1987.

14831 **Dose estimates from the Chernobyl accident.** Lange, R.; Dickerson, M.H.; Gudiksen, P.H. (Lawrence Livermore National Lab., Livermore, CA (US));. *Nuclear Technology;* **82**: No. 3, 311-323(Sep 1988).

The Lawrence Livermore National Laboratory Atmospheric Release Advisory Capability (ARAC) responded to the Chernobyl nuclear reactor accident in the Soviet Union by utilizing long-range atmospheric dispersion modeling to estimate the amount of radioactivity released (source term) and the radiation dose distribution due to exposure to the radioactive cloud over Europe and the northern hemisphere. In later assessments, after the release of data on the accident by the Soviet Union, the ARAC team used their mesoscale-to-regional-scale model to focus on the radiation dose distribution within the Soviet Union and the vicinity of the Chernobyl plant.

14832 **Reaction kinetics of iodine and cesium in steam/hydrogen mixtures.** Cronenberg, A.W. (ESA, Inc., 545 Shoup Avenue, Room 336, Idaho Falls, ID (US)); Osetek, D.J. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US));. *Nuclear Technology;* **81**: No. 3, 347-359(Jun 1988).

The chemical reaction kinetics of fission product iodine and cesium released from fuel to a steam/hydrogen atmosphere are investigated at conditions associated with severe core damage accidents. The results are used to assess the time to establish equilibrium and the ultimate chemical form of iodine and cesium as a function of gas mixture concentration and temperature conditions. Illustrative calculations are presented for interpretation of the chemical form of iodine and cesium during the Three Mile Island Unit 2 accident, as well as for recent severe fuel damage experiments. At low fusion product concentrations (fission product/steam mole ratio < 10/sup -8/), the time to establish equilibrium may be on the order of tens of seconds, with the principal species being CsOH and H1. However, at fission product/steam mole ratios exceeding 10/sup -5/, the principal species are CsOH and CsI, with an equilibrium time of — 10/sup -4/s. Concentration conditions thus influence the ultimate chemical form of fission products in a steam/hydrogen gas mixture and the time to establish thermochemical equilibrium. Fission product concentration conditions should therefore be considered in the specification of the chemical form of iodine and cesium gas-phase transport for nuclear plant accident consequence analysis.

25 ENERGY STORAGE

2501 Magnetic

REFER ALSO TO CITATION(S) 14656, 15652

2506 Thermal

REFER ALSO TO CITATION(S) 14646, 14984, 14996

14833 **(PB—89-128219/XAB) Finned-tube solid heat storages.** Saastamoinen, J.J. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Thermal Engineering). 1988. 56p. NTIS, PC E04/MF A01.

Two heat-storage constructions are considered. The first is a heat storage insulated from the surroundings. The other is a floor heat storage that gives heat from the surface to the room. A solid material is used as the heat storage medium, and a fluid is used as the heat-carrier. The heat exchange between the heat-storage medium and the heat-carrier fluid is enhanced by using plate fins on the heat-carrier tubes. The heat conductivity of the heat storage medium is usually low, and the fins may have a great effect on the rate of the heat transfer. The finned-tube solids heat storage suits well for high-temperature applications, in which usually expensive pressurized vessels are used as heat storages.

14834 **(STEV-LS—88-1) Evaluation of geotechnics and plant conditions for the lake water source heat pump plant at Vallentuna.** Rydell, B.; Magnusson, C. (Statens Geotekniska Institut, Linkoeping (SE)). (Statens Energiverk, Stockholm (Sweden)). 12 Oct 1988. 63p. (In Swedish). (SGI-VARIA—229). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756297/JAW.

The capacity of the plant is 8.5 MW and its seasonal thermal energy storage takes place in the bottom sediments of the lake of Vallentuna, Sweden, by means of lake water in polyethene tubes placed 2-6 m into the sediment. The positioning of the tubes has been investigated and the geotechnical properties of the sediment are discussed. (G.B.).

14835 **(STEV-VP—88-1) Heat pump and heat storage in an aquifer at Klippan.** Eckefeldt, U.; Norderyd, A. (Klippans kommun (SE). Tekniska kontoret). (Statens Energiverk, Stockholm (Sweden)). 1988. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756305/JAW.

An existing aquifer was found to constitute a source of energy. The surface water of a small river is led to a groundwater reserve where it is seasonally stored to be utilized during winter. The system is connected to a heat pump and heat is distributed to a district heating system of 16 MW. The planning and initial operation is described and the problems in connection with water quality are discussed. (G.B.).

14836 **An integrated economic analysis of commercial thermal energy storage.** Commes, G.A.; Kahn, E.; Pignone, C.; Warren, M. (Applied Science Div., Lawrence Berkeley Lab., CA (US));. *IEEE Transactions on Power Systems;* **3**: No. 4, 1717-1722(Nov 1988).

This paper demonstrates an integrated economic evaluation method involving several computer models. The example analysis

estimates the consequences of a hypothetical demand-side load management program intended to promote the adoption of the emerging thermal energy storage (TES) technology for cooling in commercial buildings. The method consists of three parts: (1) simulation of the load shape effects of TES; (2) estimation of the corresponding utility production cost implications; and (3) a simple cost-benefit analysis of the program. The analysis shows the program provides significant benefit to society, but even without direct incentives, it fails the no-loser test.

2508 Chemical

14837 **(DOE/ER/13675—2) [Solid state voltammetry and sensors in gases and other non-ionic media]: Performance report, April 1, 1988--March 31, 1989.** Murray, R.W. (North Carolina Univ., Chapel Hill (USA). William R. Kenan, Jr. Labs. of Chemistry). 1989. Contract FG05-87ER13675. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006586/JAW.

In the previous year, we have continued work on the experimental methods and microcells by which voltammetric measurements can be made in rigid polymer electrolyte solvents, begun to address expansion of the range of polymer solvents that can be employed, and initiated a series of solid state voltammetric and transport studies. These investigations have resulted in 6 papers published, in press, or submitted.

2509 Batteries

REFER ALSO TO CITATION(S) 14552, 15087, 15206

14838 **(IREQ—7906) Research and development on LiAl-FeS batteries.** Gauthier, M.; Morin, F.; Bellemarre, R.; Vassart, G.; Belanger, A. (Institut de Recherche d'Hydro-Quebec, Varennes (Canada)). 1979. 74p. (In French). (CE—02234). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The construction of two prototype LiAl-FeS batteries of 75 Ah capacity has been carried out and testing has been performed, with one of the cells reaching over 70 cycles of operation. This cell, containing 15 mole% of Cu/sub 2/S as additive to the FeS of the cathode, has a reactant utilization of 70%, a coulombic efficiency of 99% and a self-discharge of 1% of capacity per day at 450/sup 0/ C. Electrochemical studies were also conducted on materials suitable for electrodes in molten salt batteries. These studies have concentrated primarily on the class of materials whose structures are susceptible to lithium insertion; the best known of these is TiS/sub 2/. Voltametry studies have been completed in the cases of TiS/sub 2/, TiSe/sub 2/, and VS/sub x/ as insertion materials in the eutectic molten salt systems LiCl-KCl, LiCl-LiF-LiI and LiCl-LiF-LiBr. For TiS/sub 2/, the decrease in voltage as a function of insertion rate is more rapid at high temperature than at room temperature; this unfavorable characteristic has been studied in regard to a theoretical insertion model and seems to be attributable to the evolution of TiS/sub 2/, at high temperature, toward a sub-stoichiometric state in sulfur which would imply the presence of Ti/sup +3/ ions in the insertion scheme. Other voltametric trials seem to indicate a possible insertion of Li in graphite at high temperature. Other trials have shown the possibility of preparing TiS/sub 2/ electrochemically, in molten salts, starting from Li/sub 2/S and powdered Ti. 18 refs., 35 figs., 2 tabs.

14839 **(NORCR—7903) Electrical energy storage using the zinc-lead oxide electrochemical couple.** Davis, H.J.; Condy, A.A.; Cromwell, J. (NORANDA Centre de Recherche, Pointe Claire, Quebec (Canada)). 1979. 25p. (CE—02195). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this research was to undertake an initial assessment of the technical and economic viability of electrochemical energy storage systems ased upon the Zn-PbO couple. Various configurations of both negative and positive electrodes were investigated in electrolytes of various compositions. Optimization of electrode performace with respect to electrolyte composition was attempted. Good electrochemical performance was achieved in acidified zinc sulfate electrolyte using lead sheet and Pb-Ca grid, PbO electrodes. Coulombic efficiencies over realistic charging and discharging regimes exceeding 95% and energy efficiencies of the order of 75% have been attained. Efficient Zn utilization over a concentration range of 90 to 60 g/l has been demonstrated, indicating that total active negative material utilization in excess of 30% can be achieved. Based on recent costing information for a zinc electrowinning facility, a cost estimate for the Zn-PbO electrochemical energy storage analog have been derived. Projected capital costs of $300/kW and $100/kWh for this system compare favorably with costs derived for equivalent capacity systems based on current lead-acid technology. The projected cost of electrodes and electrolyte for the Zn-PbO system, $36/kWh, compares favorably with projections for advanced lead-acid batteries. Total energy costs appear to come close to equivalent energy generation costs for present gas turbines. 4 refs., 5 figs., 7 tabs.

14840 **(NORCR—7903) Optimization of a non-aqueous battery system for low temperature applications. Final report.** Davis, H.J.; Naherne, G. (NORANDA Centre de Recherche, Pointe Claire, Quebec (Canada)). 1979. 54p. (CE—02231). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this research were to: complete the development of a lithium-molybdic oxide electrochemical cell couple; provide a detailed description of the internal structural arrangement and fabrication procedures for the cell components; and examine storage life and cycling capability of the system. In the experimental program, a number of cathodes utilizing different material loadings were fabricated, and the total amount of active cathode material able to be loaded into a D size electrode pack for various cathode loadings was determined. Cathodes using sub-stoichiometric Mo/sup VI/oxide were also fabricated. The run time of test cathodes against lithium anodes was determined for a number of cathodes representing different active material loadings and oxide compositions. A cathode composition and structure was chosen for the test cell that would maximize the required low temperature (-40/sup 0/ C) discharge performance. The cyclic performance of cathodes containing Mo/sub 8/O/sub 23/ was investigated and very little evidence of rechargeability was observed. Low temperature discharge of a fresh D cell, containing a spiral wrap lithium anode, into a 40 ohm load gave a run time of 82 h to a 2-volt cutoff. The results of this work indicated that the lithium-molybdic oxide system is capable of providing more than 4.5 Ah from a D cell at -40 C at a discharge current of ca 55 mA, representing an attractive, low temperature energy density. The storage life of this system has not been verified, as problems with cell sealing techniques may have compromised the observed storage characteristics. 61 refs., 29 figs., 3 tabs.

14841 **(SAND—85-1737) Screening study of lithiated catholyte mixes for a long-life Li(Si)/FeS_2 thermal battery.** Giuidotti, R.A.; Reinhardt, F.W.; Hammetter, W.F. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 84p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006857/JAW.

The inability of the standard catholyte used by Sandia National Laboratories to meet all of the discharge requirements of a 60-min Li(Si)/FeS_2 thermal battery necessitated the evaluation of lithiated catholytes as a replacement. Over 100 experimental mixes were examined as part of a screening study using a 5-cell battery as a test vehicle. Parameters studied included: catholyte composition (extent of lithiation), lithiation agents (Li_2S, Li alloys, Li_2O), processing technique (single step vs. multiple step, heating conditions), type of electrolyte-binder mix used in the catholyte (SiO_2-based vs. MgO-based), and the effect of Fe_2O_3 impurity in the mix. The deformation behavior at 530{degree}C of pellets of the more promising lithiated catholytes was measured, to evaluate their behavior under simulated battery-discharge conditions. A thermoanalytical study was also conducted to help identify deleterious chemical reactions which occur during heating of the precursor mixes, and to define the chemistry associated with the lithiation processes. The better lithiated catholytes were subjected to performance-verifica-

tion tests and were then tested in the 10-cell 60-min thermal battery. The best overall results were obtained with Li_2O-lithiated catholytes, with optimum performance occurring at a Li/FeS_2 mole ratio of {approximately}0.16. The initial voltage transient which normally occurs upon activation of Li(Si)/FeS_2 thermal batteries was totally eliminated and the pulse performance of the battery near the end of life was significantly improved. 24 refs., 40 figs., 12 tabs.

14842 **(SAND—88-2852) Glossary of testing terminology for rechargeable batteries.** Butler, P.C. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1988. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007061/JAW.

The Battery Test Working Task Force was formed in 1983 for the purpose of coordinating the evaluation of development rechargeable batteries by DOE-funded labs. The Task Force developed this glossary of testing terminology to improve the accuracy of communication and to permit meaningful comparisons of test results. It consists of a section of technical terms and a separate section of programmatic phrases and acronyms. The glossary emphasizes terms related to electric vehicle batteries due to the significant development and testing activities in this area. 8 refs.

14843 **Electrolytic mass transfer to a rotating disk in dilute solutions.** Hauser, A.K.; Newman, J. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., and Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

To assess reliably and completely the contribution of migration, it is necessary to solve simultaneously the coupled, nonlinear governing differential equations for electrolytic mass transfer. This of course requires a numerical solution to the problem and previously has been done. The concentration variation of the supporting electrolyte also was calculated as a by-product of the determination of the effect of migration on limiting currents for the rotating disk. In the limit of an excess of supporting electrolyte, however, the effect of migration must be considered for only the major ions of the electrolyte. Thus, it is possible to obtain an analytic solution to the governing equations for the concentration variation of the electrolyte. An advantage of this limiting-case approach is that the analytic solution, expressed as concentration-difference ratios, provides quick and useful results about a given electrochemical system. Applications of this method will be demonstrated in this paper for systems that have a reacting supporting electrolyte.

14844 **Coulometric investigation of iron and nickel sulfides in Li/sub 2/S saturated LiCl-KCl eutectic.** Redey, L.; Woodcock, C. (Chemical Technology Div., Argonne National Lab., Argonne, IL (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Recently, the performance of the positive electrode of lithium alloy-metal sulfide cells was found to be greatly improved by the addition of NiS/sub 2/ to the FeS/sub 2/ electrode material. Previously, thermodynamic studies, cyclic voltammetric studies and one-dimensional-electrode half-cell experiments were conducted on small amounts of these materials in large volumes of the liquid electrolyte. These studies provided fundamental information about the individual materials and electrode beds but relatively little information about the interactions between the three major cell components: the positive electrode, the separator and the negative electrode. The present study is focused on investigating the metal sulfide positive electrode materials in a configuration characteristic of high performance engineering cells.

14845 **A modified gas diffusion electrode for superior performance.** Rudd, E.J.; Knerr, L.A.; Solomon, F. (ELTECH Research Corp., 625 East Street, Fairport Harbor, OH (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Fuel cells and metal/air batteries employ O/sub 2/ cathodes and/or H/sub 2/ anodes which must exhibit superior voltage performance and longevity. A carbon-based gas diffusion electrode material has been developed which fulfills these requirements for many applications. Specifically, this material has achieved 4000 hrs. of constant current operation under high voltage density (450 mA/cm/sup 2/) O/sub 2/ reduction conductions in alkaline electrolyte. Performance of this magnitude from a carbon-based gas diffusion electrode is a major achievement. It is the result of research and development to improve electrode characteristics such as catalyst activity and stability, carbon support stability, and electrode mass transport properties for both acid and alkaline applications. Modification of the chemical properties of the carbon substrate is frequently used to improve its characteristics as a catalyst support, and examples include boron doping, ammonia treatment, and gas activation. Catalyst modification techniques include heat treatment, particularly in the case of metal macrocycles, or promotion of Pt activity with other metals. Very recently, the inclusion of Nafion (DuPont) as a surface film on carbon-based gas diffusion of Pt electrodes has shown promise in enhancing fuel cell electrode performance. Employing carbon black as the catalyst support in a single layer structure to reduce air transport resistance resulted in electrodes which exhibited acceptable voltage performance in terms of absolute potential and profile. However these electrodes failed rapidly due to flooding, compared to the two-layer, active carbon material. Recent efforts at ELTECH/Electromedia have focused on combining modification of the chemical properties of catalyzed carbon with improved electrode structural characteristics to produce a superior gas diffusion electrode.

14846 **Comparison of energy conserving schemes for the chlor-alkali industry.** Taylor, E.J.; Waterhouse, R.; Gelb, A. (Physical Sciences Inc., Research Park, P.O. Box 3100, Andover, MA (US));. pp v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. Pennington, NJ; The Electrochemical Society (1987). (CONF-870560—).

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

The chlor-alkali industry is a major electrolytic industry consuming approximately two percent of the total U.S. electric power production. In this process, chlorine and caustic soda (NaOH) are produced by the electrolysis of brine (NaCl). The sodium hydroxide produced in an advanced membrane electrolysis cell is typically 30 weight percent and is concentrated to 50 weight percent commercial product. Currently, the caustic concentration is accomplished by evaporation with the by-product hydrogen burned to supply part of this thermal requirement. The electrical and thermal energy requirements for this process are approximately equal and energy conserving schemes addressing one or both of these energy requirements are attractive. The authors consider the energy impact of three energy conserving technologies at a state-of-the-art chlor-alkali plant: 1) phosphoric acid fuel cells (PAFC), 2) air depolarized cathodes, and 3) an electrochemical concentrator.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

14847 (CONF-8505394—Summ.) Status report 1985. Report of the seminar 'Local and regional energy supply concepts'. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung; Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.)). 1985. 368p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE89770234/JAW.

From Status seminar 'Local and regional energy supply concepts'; Berlin, F.R. Germany (23 May 1985).

The programme 'local and regional energy supply plans' was initiated by the Federal Government in 1980. As an interdisciplinary programme it is simultaneously financed and controlled by the Federal Ministry for Research and Technology and the Federal Ministry for Environmental Planning, Construction and Urban Development. Three subject areas are covered by the programme, corresponding to the given tasks: - Parameter studies, - planning studies, - studies on the structure of housing development. This document reports the results of an examination of 28 energy supply concepts.

14848 (DOE/EIA—0173(88)) Annual report to Congress 1988. (USDOE Energy Information Administration, Washington, DC). 6 Jan 1989. 64p. NTIS, PC A04/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006896/JAW.

This is the Energy Information Administration's (EIA) annual report to Congress. The report contains EIA's: accomplishments; energy findings; and special analyses performed. (JF)

14849 (ESC-WR—88-24) Impacts of environmental and price constraints on future heat pump applications in the Netherlands. Okken, P.A.; Boswinkel, H.H. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Nov 1988. 18p. Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 2. workshop on research activities on advanced heat pumps, Graz, Austria, 26-29 September 1988.

The Netherlands Energy Research Foundation recently completed an extensive study on emerging energy technologies up till the year 2020. In this study, possible future penetrations for gas-engine, gas-absorption and electric heat pumps for low temperature heating in 8 markets were assessed in different energy scenarios to the year 2020. Scenario calculations were made with the IEA-MARKAL model code for the Netherlands energy system. In all energy scenarios the gas-absorption and gas-engine heat pumps appear macro-economical attractive. Low temperatures heating market share could be 30% to 40% in 2020. On the other hand electric heat pumps do not penetrate significantly in any of the scenarios. To test the robustness of the heat pump option, sensitivity analyses were made on environmental constraints, absorption heat pump investment costs and energy prices. Gas-absorption heat pumps are favoured by national ('bubble') NO/sub x/- and SO/sub 2/-emission constraints. The gas-engine heat pump penetration remains unchanged despite it's high NO/sub x/-emission. All heat pumps are stimulated by higher energy prices. Whether smaller and medium-scale absorption heat pumps will eventually succeed however remains to be seen. A too expensive absorption heat pump is likely to be overruled by other heating techniques. R and D programs for absorption heat pumps should be directed towards mass-production and -marketing. 8 figs., 6 refs., 3 tabs.

14850 (NP—9770235) Birkenhof model plan. Further development of the energy-saving housing concept 'Frohnhof plan' with special consideration of the passive use of solar energy. Final report of the planning phase. Morovic, T.; Overkott, S.; Pilhar, R. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1987. 175p. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770235/JAW.

Various measures, especically the setting of standards, the up-dating of technical norms, a large number of technical improvements and not least consumer education, have led to a reduction in the consumption of energy for heating purposes. The coordination of energy-saving measures at the construction and fitting stage in the planning of individual buildings has led to further progress in reducing consumption. This research plan investigates the possibility of reducing still further final energy consumption for heating purposes while at the same time minimizing annual heating costs. The starting-point chosen for this was the Frohnhof Plan, developed in 1975, which is an examination of the system of supply for groups of houses or estates on a multi-unit basis. This plan is meant to lead to a reduction in the energy requirement for heating in excess of the amounts usual today, through coordinated energy-saving measures in urban development and construction together with the advantages of community heating.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 14487, 14496, 14635, 14647, 14836, 14848, 14849, 14860, 14867, 14868, 14880, 14892, 14896, 14902, 14928, 14929, 14930, 14931, 14932, 14935, 14936, 15004, 15011

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 14142, 14147, 14297, 14357, 14393, 14394, 14396, 14826, 14855, 14869, 14884, 14887, 15967, 15971, 15975, 16139

14851 (NP—9770233) Establishment of environmental protection in Basic Law. Public hearing of the Law Committee of the German Bundestag on October 14, 1987. (Deutscher Bundestag, Bonn (Germany, F.R.)). 1988. 280p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE89770233/JAW.

The legislature faces difficult problems when it has to decide how it can most effectively contribute to a realization of environmental protection. The aim of the public hearing set up by the Law Committee was to prepare the ground for this decision and to hear the views of experts on the draft bills presented by the Bundesrat, the SPD party and the Greens party. The written statements, given here, and the oral hearing demonstrate the wide range of possible different aspects of the consequences of fixing a national objective and shaping it in detail. In addition opinions are presented on the formulation of a national objective from the basis of an anthropocentric starting-point, or on the meaning and scope of a legal reservation or a stipulaton, as well as on the possibilities of the systematic integration of a national objective into the Basic Law. (orig./HSCH).

14852 (PB—89-129092/XAB) Production and management of small-quantity-generator hazardous waste in Florida. Herndon, R.C.; Moerlins, J.E.; Jones, E.B.; Lambou, V.W.; Koutsandreas, J.D. (Florida State Univ., Tallahassee (USA). Center for Biomedical and Toxicological Research and Hazardous Waste Management). Nov 1988. 36p. NTIS, PC A03/MF A01.

Data are presented on the production and management of hazardous waste by approximately 20,000 small-quantity hazardous waste generators (SQHWGs) in the state of Florida. SQHWGs are generators that produce less than 1000 kilograms of hazardous-waste in a calendar month. These data were collected as part of the Florida Local-Government Hazardous-Waste Assessment Program and made available to us for analysis. There were approximately

117,000 metric tons of small-quantity-generator (SQG) hazardous waste produced annually. Approximately half of this hazardous waste is managed using the following methods: recycling, treatment, and disposal in permitted hazardous-waste-management facilities. However, large quantities of the SQG hazardous waste are disposed of in sanitary landfills and discharged to public sewers and these facilities are typically not designed to handle hazardous waste.

14853 (PB—89-129886/XAB) Development of methods to estimate beryllium exposure. Final report. Rice, C.H. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 30 Jun 1988. 134p. NTIS, PC A07/MF A01.

The project was designed to access data, provide preliminary exposure rankings, and delineate the process for detailing retrospective exposure assessments for beryllium among workers at processing facilities. A literature review was conducted, and walkthrough surveys were conducted at two facilities still in operation. More than 8000 environmental records were entered into a computer file. Descriptive statistics were then generated and the process of rank ordering exposures across facilities was begun. In efforts to formulate crude indices of exposure, job titles of persons in the NIOSH mortality study were reviewed and categorized for any beryllium exposure, chemical form of beryllium exposure, and exposure to acid mists. Daily Weighted Average exposure estimates were reviewed by job title, across all facilities. The mean exposure at each facility was calculated. The strategy developed for retrospective exposure assessment is described. Tasks included determination of the usefulness of the Pennsylvania Workers' Compensation files; cataloging the numbers of samples available from company sources; investigating data holdings at Oak Ridge National Laboratory; and obtaining records from the Department of Energy Library.

2904 Natural Resources

REFER ALSO TO CITATION(S) 14883, 16015, 16016, 16017

14854 (CFS/OO—1971) Forest resources and utilization in Canada to the year 2000. Manning, G.H.; Grinnell, H.R. (Canadian Forestry Service, Ottawa, Ontario). 1971. Vp. (CE—02178). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents estimates of the relation between the demand for Canada's forest products and the supply of timber available to meet this demand. The future of the Canadian forest products economy is forecast at 5-year intervals from 1975 to 2000, and the demand for individual products and product groups, both domestic and export, is shown. These estimates are then used to derive estimates of roundwood demand for the projection periods. The report then describes the timber resource of Canada, quantitatively and qualitatively, and discusses the factors that influence the growth and mortality of this resource. Factors which might change, and therefore affect the utilization of this forest resource, are also discussed. It is concluded that at the national level of data aggregation, no physical shortage of wood fiber is indicated, although on the bases of region, species, and timber quality, imbalances can exist. One important limiting factor to the supply situation is the inaccessibility of much of Canada's timber. Accessibility is increasing, and utilization is improving through harvesting technology, but the major opportunity for improvement seems to lie in the area of manufacturing technology. If the large hardwood surplus already within allocated forest areas were used in manufacturing, a considerable part of the projected demand could be met without opening up new forest areas. With respect to forest development, serious problems have been observed stemming from inadequate resource data and planning. These problems will have to be remedied if economic supplies are to be available in the future. 37 refs., 16 figs., 54 tabs.

14855 (EC—8307) Environment Canada and the north: the perceptions, roles and policies of the environment regarding development north of 60/sup 0/. (Environment Canada, Ottawa, Ontario). 1983. 67p. (MICROLOG—83-4230; CE—02078). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The Canadian Department of the Environment (DOE) has a general responsibility to advocate environmental interests, and to advise government bodies on measures needed to protect and enhance the quality of the natural environment in Canada's North. In addition, it has a number of more specific Northern roles, including research and development, management of natural resources, weather forecasting, coordination of environmental emergency responses, environmental monitoring, acting as a science and policy advisor, providing public information, and operating Northern facilities. With the increased pace of industrial activity in the North, a number of priority issues and needs in Northern environmental management have been identified for the DOE. These generally relate to such areas as resource use policy, protection of environmentally significant areas, Arctic shipping and marine oil spills, transportation corridors and associated impacts, safe industrial operations under adverse conditions, and transboundary impacts. The most general and overriding principle governing the DOE's Northern policy is that all dimensions of Northern development must incorporate conservation concepts. The basic policy goal is to ensure that DOE's programs and activities contribute effectively and efficiently to the protection and enhancement of environmental quality in Canada's North, and to the achievement of environmentally sound, safe and sustainable Northern development. Four objectives, directly linked to the priority needs in Northern environmental management, are outlined, along with strategies to achieve the objectives of DOE's policies. 8 refs., 1 fig.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 14138, 14246, 14248, 14433, 14507, 14510, 14633, 14881, 14933, 14936, 14940, 14941, 14962, 14985, 15013, 15014, 15025, 15041, 15042, 15052, 15053, 15070, 15088, 15312, 15566, 15645, 15648, 15650, 15786, 15919

14856 (CONF-8811137—1) Transferring Argonne technology to industry. Frost, B.R.T. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003962/JAW.

From Midwest Tech II '88; Downers Grove, IL, USA (15 Nov 1988).

Argonne National Laboratory (ANL) is a Department of Energy (DOE) multiprogram laboratory located in southeastern DuPage County, Illinois. In the course of its energy research and development activities ANL develops technology which can be used by industry. Over the past five years, ANL has explored a number of ways to effectively transfer this technology. The most far-reaching way has been the acquisition of ANL intellectual property by The University of Chicago, Argonne's operator, through the enactment of new federal laws. This led to the formation of the ARCH Development Corporation, which owns the patents and licenses them to industry or creates new companies and ventures. One of its earliest licenses was with a small business created by a former Argonne employee, who has established his laboratory at Moraine Valley Community College. The State-of-Illinois-supported Technology Commercialization Center at Argonne has also played an important role in the technology transfer process by counseling and supporting the activities of small, often newly created businesses in the collar counties and by assisting firms in proposing R and D for funding by the federal agencies' SBIR programs. Several Argonne spin-off companies have been successful in getting these grants. The discoveries of high-temperature superconductors resulted in a large increase in Argonne's superconductivity R and D program together with a campaign to involve industries, large and small, in Illinois and nationally. Argonne is essentially carrying out a number of experiments in technology transfer to discover what works and what does not. There are many examples,

other than those cited in this abstract, such as industry-wide initiatives and consortia, which are described in the full paper.

14857 **(CONF-8811138—1) Overview of the Chemical Technology Division, Oak Ridge National Laboratory.** Genung, R.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004917/JAW.

From Research and training opportunities conference; Oak Ridge, TN, USA (29 Nov 1988).

The Chemical Technology Division (Chem Tech), which has {approximately}350 staff members, is the largest research and development (R&D) division at Oak Ridge National Laboratory (ORNL). The Division has outstanding facilities and personnel capabilities in chemical engineering and chemistry, as well as significant competence in several other engineering and scientific disciplines. It has major roles in a broad range of ORNL programs for which chemical processing is a critical element. These programs are designed to explore selected aspects of nuclear and nonnuclear energy technologies and to develop advanced processes and systems to meet national priorities. Research and development activities include basic and applied research and engineering, engineering development and assessments, and the operation of various pilot plants and specialized facilities. Most of the research programs are funded by the US Department of Energy (DOE), although some important projects are carried out for other government agencies, and limited support is derived from industrial sources. The major objectives of Chem Tech are addressed.

14858 **(DOE/EIA—0249(88)) Directory of energy data collection forms: Forms in use as of October 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Statistical Standards). 1988. 64p. NTIS, PC A04/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006997/JAW.

All DOE forms designed to collect energy information and used by the EIA that had Office of Management and Budget (OMB) approval on October 1, 1988, are in this directory. For each form listed in this directory, an abstract is included that describes the form's uses, its respondents, and the data collected. Also shown are certain frequently requested items of information. These items include the general energy source(s) and function(s) covered by the forms; the general categories of respondents; the frequency of collection; the public laws and, if applicable, regulations associated with the collection; the requirement for reporting; the name and phone number (Washington area code 202 unless noted otherwise) of the data collection manager; and the publications resulting from the data collection.

14859 **(ECN—88-168) Proposal for the two-years-plan electrical conversion techniques (ECT).** De Bonte, J.A.; Hoeijmakers, M.J. (Netherlands Energy Research Foundation, Petten). Oct 1988. 21p. (In Dutch). Stichting Energieonderzoek Centrum Nederland, P.O. Box 1, 1755 ZG Petten, Netherlands.

Firstly the definition of the problem and the aim will be described. Then an overview is given of the areas of special attention with regard to the Electric Conversion Techniques which could be suitable for further research within the Netherlands Energy Research Foundation (ECN). From these areas a selection is made which can realize the aim as efficient as possible. For the selected activities the manpower, the planning and the required facilities are indicated. Finally an overview is given of the external orders which can be expected wihtin this framework. 2 figs., 2 tabs.

14860 **(NEI-DK—128) Structural analysis of the Danish windmill industry.** (Limes Consulting A/S, Gentofte (Denmark)). Sep 1988. 76p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756278/JAW.

Most Danish windmill manufacturers have experienced a grave economic crisis during the last three years. In 1987, the total windmill industry in this country ran at a loss of 40 million Danish crowns where the turnover was 550 million crowns. Danish firms are too small and seem to lack professional management. Production costs are too high and there is an urgent need for structural rationalization. Danish windmills cannot at the present time compete with the foreign market, largely because of lack of marketing know-how and financial backing. Yet today, many countries energy policies include the development of renewable energy resources, especially in the case of wind power. This should mean that the world market for windmills will increase, but so will the number of foreign competitors. The authors suggest the merging of Danish windmill manufacturing firms, and these mergers should include corporations that produce electricity. Possibilities for raising financial backing for running costs and export activities are mentioned, and ideas for rationalizing and reconstructing the whole Danish windmill industry are described in detail. (AB).

14861 **An integrated approach to commercialization and R and D planning with emphasis on Japanese methods.** Harrer, C.D.; Howard, C.D.; Smith, R.M. (Pacific Northwest Laboratory, Richland, WA (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

This paper identifies the problems associated with commercialization of new technologies, examines the institutional mechanisms for coordinating technology R and D and commercialization in Japan and presents a framework for integrating R and D and commercialization activities. Eventual commercialization of a new technology developed as part of R and D efforts is crucial if the full benefits of these efforts are to be realized. However, a number of problems often impede successful commercialization. Included among these problems are the lack of a commercial perspective and capital on the part of R and D interests, the low priority attached to technology monitoring by business interests, and competitive pressures which limit the flow of information.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 14430, 14433, 14459, 14726, 14727, 15791, 15897, 15919, 15971, 16796, 16830, 16831

14862 **(CONF-861010—24) The influence of the accident at Chernobyl.** Blix, H. (International Atomic Energy Agency, Vienna (Austria)). 1986. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006119/JAW.

From 13. world energy conference; Cannes, France (5 Oct 1986).

This is the text of a lecture delivered at Round Table No. 7, on "The future for nuclear power," at the 13th Congress of the world Energy Conference at Cannes on 7 October 1986. The paper covers aspects of nuclear power as it relates to economics and energy dependence, in the wake of the Chernobyl accident. (JL)

14863 **(DOE/S—9006836) United States Department of Energy nuclear weapons complex modernization report: Report to the Congress by the President.** (USDOE, Washington, DC). Dec 1988. 35p. NTIS, PC A03 - OSTI. Order Number DE89006836/JAW.

The major assumption in this Plan is that nuclear weapons will remain a principal element of the security of the United States for the foreseeable future. The Nuclear Weapons Complex (Complex) of the US Department of Energy (DOE) provides the nuclear weapons that support the nuclear deterrent policy. This support includes production of nuclei material; design and manufacture of nuclear weapons; surveillance and maintenance of nuclear weapons in the stockpile; research, development, and testing of nuclear devices; and modernization of the nuclear weapons stockpile. Much of the Complex was constructed more than 30 years ago. Some facilities are experiencing operability problems due to obsolete equipment and operational systems and to stresses in complying with more stringent environmental, safety, and health standards and requirements. Many facilities throughout the Complex are approaching the end of their useful lives. For example, the existing production reactors, at their current power limits, have limited operational capability. All three reactors are shut down for safety system improvements and are not expected to be fully operational until late 1989. In spite of these improvements and increasingly extensive mainte-

nance, the reactors may not be able to achieve acceptable production efficiencies. Other elements of the Complex, as discussed in the report, are approaching a similar critical state to that of the production reactors. Correcting these inadequacies and placing these operations in an exemplary condition will require the support of both the Congress and the Administration to a major, long-term modernization effort. 11 figs., 1 tab.

14864 **(INIS-XN—148) Public understanding of radiation protection concepts.** (Nuclear Energy Agency, 75 - Paris (France)). 1988. 121p. (CONF-8711272—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705382/JAW.

From NEA workshop on public understanding of radiation protection concepts; Paris, France (30 Nov 1987).

The Chernobyl accident in April 1986 clearly showed that communication with the public was one of the areas where there was a strong need for improvement, particularly concerning the nature and extent of the information provided by national authorities. The countermeasures adopted by public health authorities also raised difficulties in terms of public understanding and acceptance due, in part, to the perception of discrepancies in national, regional or local response to the accident, but also to a more basic lack of comprehension of the complex radiation protection considerations involved. In an attempt to help improve the situation, the NEA Committee on Radiation Protection and Public Health decided to organise a Workshop on public communication in the event of a nuclear accident, centered on radiation protection issues. The purpose of this Workshop was to analyse appropriate methods and language to be used when explaining to the public the scientific concepts underlying radiation risks and radiation protection, and the technical rationale for the choice of protective actions in an emergency. Separate abstracts were prepared for individual papers presented at the meeting.

14865 (INIS-XN—148, pp 8-65) **Informing people about radiation risks: a review of obstacles to public understanding and effective risk communication.** Covello, V.T. (Center for Risk Communication School of Public Health Columbia Univ. New York (USA)). 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705382/JAW. (CONF-8711272—).

From NEA workshop on public understanding of radiation protection concepts; Paris, France (30 Nov 1987).

This paper reviews the literature on informing people about radiation risks. The paper focuses on obstacles to public understanding and effective risk communication. The paper concludes with a set of guidelines for communicating information about radiation risks to the public. The paper also includes an appendix that reviews the literature on one of the most important tools for communicating information about radiation risks: risk comparisons.

14866 (INIS-XN—148, pp 66-79) **Results of the research and studies concerning the information about the Chernobyl nuclear disaster.** Landahl, P.A. (National Board of Psychological Defence, Stockholm (Sweden)). 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88705382/JAW. (CONF-8711272—).

From NEA workshop on public understanding of radiation protection concepts; Paris, France (30 Nov 1987).

The studies conducted by the National Board of Psychological Defence after the Chernobyl nuclear accident concern questions of great importance about crisis information. The Chernobyl fallout created problems for the mass media and the authorities. Both lacked individual preparedness. The knowledge necessary to face strong demands for information from the public was lacking. A sign of this lack of knowledge and experience was shown when individual journalists - contrary to their usual behaviour - uncritically accepted the sometimes ambiguous information coming from the central authorities. For the authorities it was very much the same. The expert authority, the National Institute for Radiation Protection, had quite a lot of know-how, but no resources for such extensive information as the situation required. Significant problems must be solved concerning the cooperation between central and regional authorities. Direct contacts must be established so that both types of authorities do not learn through mass media what has been decided. The wordings of the messages conveyed in such critical situations must be a matter of more concern. Facts known by the authorities must be presented in a way comprehensible to the public. Technical terms and units must be used with great care. Negative information must of course be presented but measures should be taken to countermand the negative effect. A special responsibility should rest with the school system. The difficulties of informing the public after the Chernobyl disaster were still more emphasized by the study of how the brochure After Chernobyl was received.

14867 **(X-EP-CE-RA—1985) Annual report of the Econometrics Center, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 22p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756690/JAW.

Research on social decision making theory and voting; public regulation and pricing; spatial planning of real estate markets; technological risks and crisis management; and private demands on public services is presented.

14868 **(X-EP-CE-RA—1986) Annual report of the Center for Econometrics.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 14p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756691/JAW.

Research on social decision making theory and voting; public regulation and pricing; spatial planning of real estate markets; technological risks and crisis management; and private demands on public services is presented.

14869 **Role of nuclear power in the U.S. energy future.** Rossin, A.D. (U.S. Dept. of Energy (US));. pp v of Energy in Illinois and the Midwest: The changing economic and regulatory scene. Springfield, IL; Illinois Dept. of Energy and Natural Resources (1987). (CONF-8610132—).

From 14. annual Illinois energy conference: energy in Illinois and the Midwest - the changing economic and regulatory scene; Chicago, IL, USA (30 Oct 1986).

On April 26, 1986, the world's worst nuclear reactor accident occurred. By now Chernobyl, the site of this event, is a household word in much of the world. The author speaks about the domestic and international impacts resulting from the accident at Chernobyl. The Chernobyl accident has raised the level of interest in international cooperation. There is a tremendous wealth of experience and technical data that can be applied to the benefit of all nations. Increased emphasis on international cooperation in the area of nuclear safety is needed to bring the levels of safety associated with use of nuclear power by all nations to a new higher standard of excellence. There are some early signs that Chernobyl will help open the gates to allow sharing of safety-related technology. If this can be accomplished, then we should you see continued improvements in the safety of existing and future power plants of all types and sizes. Tangible evidence in the form of improved plant capacity factors (dollars) and fewer incidents or accidents (public confidence), will improve the prospects for nuclear power.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 14873, 14922, 15017

2910 Conservation

REFER ALSO TO CITATION(S) 14495, 14859, 14999, 15010, 15035, 15041, 15043

14870 **(DOE/CE/27479—T1) Organizational barriers to the performance of least-cost planning-related research: Final report.** (Wisconsin Public Service Commission, Madison (USA)). 1989. Contract FG01-87CE27479. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006499/JAW.

This report is organized into three sections. Section 2 provides a more complete discussion of the development of the WCDSR, including a review of problems that were overcome in developing it; the level of innovation resulting from the center; the potential for the center to become self-sufficient; the degree to which the center leveraged federal resources and resulted in link-

ages with other organizations; and the potential applicability of Wisconsin's experiences to other states wishing to develop a cooperative DSM research center. Section 3 provides a more detailed report on the research projects conducted under the grant, and is organized in the same manner as Section 2. Finally, Section 4 summarizes the impact of both parts of the project, and provides a source for further information regarding either the WCDSR or the research projects discussed in this report.

14871 **(DOE/CE/40806—T1) Energy management assistance for small and medium-size manufacturers: Manufacturers' evaluations of EADCs' services, 1987--1988.** Kirsch, F.W. (University City Science Center, Philadelphia, PA (USA). Industrial Technology and Energy Management Div.). Jan 1989. Contract FC01-87CE40806. 34p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006753/JAW.

Small and medium-size manufacturers continue to express strong confidence in and satisfaction with the energy-conserving and cost-saving services provided by the Energy Analysis and Diagnostic Centers. That conclusion is based upon in-depth interviews with 243 of the 388 manufacturers (63%) served during 1987--1988 by an EADC. These interviews were conducted at the manufacturing plants by engineers from the Industrial Technology and Energy Management (ITEM) division of University City Science Center, which manages the EADC program under agreement with the Office of Industrial Programs, US Department of Energy. University engineering faculty and a mix of graduate and undergraduate students who make up the staff of each EADC perform energy audits under subcontract to the Science Center at manufacturing plants which are located within about 150 miles of the university. This report presents the chief results obtained during two series of interviews with 63% of the manufacturers in 36 states served by 13 EADCs during 1987--1988. These include the principal benefits derived by the manufacturers, the extent to which EADCs' recommendations are being understood and implemented, and the manufacturers' perceptions about the ways EADCs carry out their dual mission of industrial service and educational enrichment. The 243 manufacturers interviewed represent 19 different industries (2-digit SIC codes), and they collectively employed over 39,700 persons and sold more than $4.7 billion worth of products and services during the past year. 4 figs., 5 tabs.

14872 **(DOE/CE/64612—T2) Developmental state programs for institutional conservation: Ohio Public Facilities Maintenance Association Final report.** (Ohio Dept. of Development, Columbus (USA). Office of Energy Conservation). 12 Jan 1989. Contract FG01-86CE64612. 528p. NTIS, PC A15 - OSTI. Order Number DE89006374/JAW.

The objective of Ohio's Tier I Grant was to establish an Association to serve the needs of individuals responsible for the operation and maintenance of public buildings. This Association would provide needed technical information, technical assistance and training on all aspects of operating and maintaining a public facility. The need for an association to serve this purpose has been recognized for some time. However, the financial support necessary to establish such an association had not been available. The Tier I grant, awarded to the Ohio Department of Development, Office of Energy Conservation, provided the seed money essential to the formation of an association to serve the needs of individuals responsible for the operation and maintenance of public buildings possible. This financial assistance along with the support and commitment of many dedicated individuals have made the Ohio Public Facilities Maintenance Association (OPFMA) become a reality. OPFMA is a non profit membership organization dedicated to serving the informational and educational needs of people responsible for the operation and maintenance of public facilities. This report overviews the development of this program.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 14336, 14848, 14869, 14885, 14897, 14905

14873 **(DOE/EIA—0202(89/1Q)) Short-term energy outlook: Quarterly projections, January 1989.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 6 Feb 1989. 62p. NTIS, PC A04/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006894/JAW.

Low oil prices and further economic growth will continue to encourage a growing appetite for jet fuel and motor gasoline in the transportation sector. Some significant switching from gas to oil at utilities is expected to have carried over from late 1988 into early 1989. Hence, total petroleum consumption this year should expand by about another 180,000 barrels per day. Next year, however, a slowdown in the trade sector-led boom in the general economy and the assumption that oil will not maintain its recent level of use at utilities dampens projected growth in domestic oil demand. Nevertheless, since additional petroleum supplies will come not from domestic resources but from foreign production, net oil imports are anticipated to continue a strong increase over the period.

14874 **(DOE/EIA—0383(89)) Annual energy outlook 1989 with projections to 2000.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 10 Jan 1989. 81p. NTIS, PC A05/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006893/JAW.

The United States consumed more energy during 1988 than in any previous year in its history; and US demand for petroleum hovered at about 17 million barrels per day -- the highest point since 1980. Encouragingly, however, the past year also showed that a strong underlying trend toward greater energy efficiency is continuing ... and that competition for oil from other energy sources (except in the transportation sector) remains a persistent natural curb on petroleum use. US consumption of energy in all forms increased from 76.8 quadrillion British thermal units (quads) during 1987 to an estimated 79.4 quads in 1988. However, this took place in the context of continuing low oil prices, an economic boom, and unusual extremes in temperature that pushed up energy use in both cold and hot weather. Considering those circumstances, the rise was modest. Nevertheless, if real gross national product (GNP) grows at an average of 2.5 percent annually (actually, a slower pace than the Nation has set since 1970) while average crude oil prices increase only gradually to the equivalent of $28 per barrel by the end of the century (the projection of this Annual Energy Outlook), the AEO "base case" calculations suggest that the Nation will be using over 90 quads by the year 2000. Under these assumptions, a decline in US domestic oil production will force importation of more than half the petroleum used here as soon as 1994. 20 figs., 7 tabs.

14875 **(DOE/FE—9006925) Energy market and fuel supply/demand monitor.** (Hagler, Bailly and Co., Washington, DC (USA)). Jan 1987. 79p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006925/JAW.

US energy market is discussed. Supply and demand, consumption and prices of coal, petroleum, and natural gas are addressed. 26 figs. (CBS)

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 14297, 14393, 14394, 14396, 14495, 14884, 14886, 14890, 14925

14876 **(CONF-8810273—) US--Japan energy policy consultations.** (Atlantic Council of the United States, Washington, DC). 1989. Contract FG01-88IE10688. 126p. NTIS, PC A07 - OSTI. Order Number DE89003853/JAW.

From US-Japan energy policy consultations meeting; Mauna Kea, HI, USA (16 Oct 1988).

These papers, from the US--Japan Energy Policy Consultations Meeting in Hawaii, deal with topics relating to: energy out-

look; electric utilities; nuclear energy; coal and petroleum based energies; and new energy source development. (JF)

14877 **(DOE/E/10607—H1) State and federal roles in energy emergency preparedness.** (National Research Council, Washington, DC (USA). Commission on Engineering and Technical Systems). Jan 1989. Contract FG01-87IE10607. 61p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006796/JAW.

In the early part of 1988, in response to a request from the US Department of Energy's (DOE) Office of Energy Emergencies, the National Research Council formed the Committee on State and Federal Roles in Energy Emergency Preparedness. This committee was charged with providing an independent assessment of the current arrangements among federal, state and industrial units for planning for and managing energy emergencies, and with recommending courses of action that DOE and the states could take to improve the overall level of energy emergency preparedness in the United States. 27 refs., 3 tabs.

14878 **(DOE/EIA—0448(86)) Drilling and production under Title I of the Natural Gas Policy Act, 1978--1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Jan 1989. 135p. NTIS, PC A07/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006891/JAW.

This study examines and analyzes the supply side of the natural gas wellhead market since the Natural Gas Policy Act (NGPA). Until demand began to change profoundly in later 1982, the NGPA appears to have had the intended effect on the drilling and production activities of natural gas producers: new wells were drilled, additional new reserves were discovered, and deliverability of gas increased. But the cost was enormous, since the ordering of drilling was contrary to the normal market ordering. The very thin cushion of nonregulated gas pushed marginal prices beyond $10 per thousand cubic feet (1982 constant dollars, or more than $12 per thousand cubic feet in 1988 constant dollars), with the result that high-priced reserves were being developed while potentially available low-priced resources remained undiscovered. Whether the NGPA succeeded in holding prices to end users at acceptable levels is a matter of question. Some people argue that the NGPA was successful along these lines because the process of averaging high-cost gas in with large volumes of low-cost gas permitted prices to rise in a controlled manner. Others claim that the NGPA had a perverse effect on prices. 37 figs., 66 tabs.

14879 **(DOE/IG—0008/10-6) Office of Inspector General semiannual report to the Congress, April 1 to September 30, 1988.** (USDOE Office of Inspector General, Washington, DC). Nov 1988. 69p. H. Order Number TI89007098/JAW.

Report to the Congress.

The semiannual report of the Office of Inspector General's 6-month period ending September 30, 1988, meets the requirements of Section 208(c) of Public Law 95-91, as amended. Our audit, inspection, and investigative activities during this period continued to focus on identifying opportunities to enhance the effectiveness, efficiency, and integrity of the Department of Energy's programs and operations. Implementation of corrective action on the conditions summarized in this report will help in achieving improvements throughout the Department. The 163 audit and inspection reports issued and 91 investigative cases closed resulted in management committing to more efficient use of funds totaling $96.4 million, recoveries of $392,884, 9 convictions, and 21 prosecutive and administrative referrals. The following sections of the report detail the accomplishments of the OIG for the second half of Fiscal Year 1988. The report is organized into four major sections. The first section presents an overview of the Department. The second section describes the significant operational results of our audit, investigative, and inspection programs. The third section discusses the OIG activities during the past 6 months to support Presidential and Congressional concerns, and the final section presents an overview of the Office of Inspector General and describes the major management initiatives within our office to build on past accomplishments and to increase the effectiveness and efficiency of our operations.

14880 **(EMR—1982) The National Energy Program, update 1982.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1982. 99p. (MICROLOG—82-3509). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The report provides an updated report on the progress of a Canadian program undertaken to achieve security of oil supplies, provide opportunities for Canadian participation in the national oil and gas industry, and to ensure fairness in the distribution of energy benefits and burdens. Elements of the program, which may change as conditions warrant, include programs to encourage oil substitution, energy conservation, research and development, use of renewable energy, and development of conventional energy sources; fiscal measures to benefit the oil and gas industry; policies for resource management of federal lands; and programs to promote developments in regions with special energy-related problems. Recent changes are discussed which affect the energy sector, and thus the energy program: these include oil/gas resources agreements with the provinces, the worldwide economic recession, and a decline in oil consumption. Issues requiring action by the program are presented, including the growing surplus of natural gas, expanding the gas supply infrastructure to eastern regions, the tightening of the nuclear power market, and large volumes of shut-in oil in the western regions. The report concludes with an outlook for the future Canadian energy situation and the corresponding role for government policy. An overall conclusion is that Canadians now have a stable environment guaranteeing made-in-Canada energy prices for the next five years, and that oil imports will probably not reach their 1980 peak again. 14 figs., 12 tabs.

14881 **A user's guide to the national labs.** Baron, S.; Marcuse, W. (Brookhaven National Lab., Upton, NY (US));. *Mechanical Engineering;* **110**: No. 9, 79-83(Sep 1988).

Recent initiatives by the Congress and the Administration have been directed to improving American industrial competitiveness. One of these initiatives is directed to encouraging industrial users to avail themselves of special facilities at the Federal Laboratories. The facilities available at the National Bureau of Standards (NBS) and seven Department of Energy (DOE) laboratories are presented here. One facility at each Laboratory is described in detail, the remainder are listed with the names of individuals to contact for further information. The seven laboratories are: Argonne, Brookhaven, Lawrence Berkeley, Los Alamos, Oak Ridge, Sandia and Lawrence Livermore.

14882 **US-Japan energy policy considerations for the 1990s: A joint project of The Atlantic Council of the United States, the Japanese Committee for Energy Policy Promotion, and the Japanese Institute of Energy Economics.** Gray, J.E.; Nakayama, Yoshihiro (eds.). Lanham, MD; University Press of America, Inc. (1988). 118p. University Press of America, Inc., 4720 Boston Way, Lanham, MD 20706. Order Number TI89003351/JAW. Contract FG01-88IE10688.

From U.S.-Japan energy policy considerations for the 1990s; Washington, DC, USA (11 Nov 1987).

In 1981, the Atlantic Council's Energy Policy Committee, in collaboration with the Japanese Committee for Energy Policy Promotion and the Japanese Institute of Energy Economics, published the conclusory results of their consultations as a joint policy paper entitled "US-Japan Energy Relationships in the 1980s." The paper consisted of US and Japanese views on bilateral energy relations, together with a series of joint policy recommendations addressing the security of energy supplies, the need for more efficient use of energy, and the benefits to be derived from closer US-Japan collaboration in these matters. The report went on to recommend that "both Japan and the United States should endeavor to deepen recognition of the importance of US-Japan energy relationships among their respective peoples and their respective legislative bodies."

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 14125, 14138, 14142, 14143, 14183, 14184, 14184, 14221, 14222, 14254. 14265, 14278, 14282, 14284, 14285, 14286, 14297, 14319, 14320, 14323, 14324, 14331, 14332, 14336, 14337, 14338, 14338, 14873, 14875, 14875, 14875, 14898, 16159

14883 **(DOE/FE/60562—T1) Alternative fuels-data base development project: Final report.** (Garfield County Dept. of Building, Sanitation and Planning, Glenwood Springs, CO (USA)). [1989]. Contract FG01-84FE60562. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006452/JAW.

In 1984, Garfield County, Colorado, and the US Department of Energy entered into a grant agreement to formulate a comprehensive procedure for evaluating and permitting large scale energy projects in a manner acceptable to both the private sector and public sector parties involved in the process. High grade, easily accessible oil shale deposits are located in Garfield County. Since the turn of the century, various people have been interested in developing a commercially viable oil shale industry. During the later half of the 70's and early 80's, privately owned oil shale projects were initiated on a much larger scale than previously. Financing and developing infrastructure capable of handling the rapid population growth was a key issue in the permitting of these projects. Based on these experiences, industry support and the expectation that in the reasonably near future, there will be new and expanded projects, the DOE and County initiated this project. The initial project consisted of five basic elements: (1) development and adoption of a unified regulatory process; (2) development of a budget based fiscal impact assessment procedure; (3) preparation and implementation of an Energy Development Impact Monitoring System; (4) development of a Housing Impact Estimation System; and (5) development of a School District Impact Estimation System. These elements are discussed.

14884 (EMR/E—1976, pp 43-45) **Alberta coal development policy.** Mellon, G.B. (Ministry of Mines and Petroleum Resources, Alta.). 1976. Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

A new coal development policy for Alberta, announced in 1976, is designed to provide maximum benefits for Albertans while maintaining reasonable incentives to industry for continuing development of coal resources. An important feature of the policy is the recognition that a reasonable balance between resource development and environmental protection must be maintained, and that coal exploration and mining activities must be compatible with alternative land uses. The policy provides for the classification of the province's land surface into broad categories for the purposes of coal exploration and development. Pricing policy provides for review and redetermination of prices at 2-year intervals. A royalty formula is set out in the policy that is structured to provide a flexible royalty rate; for new mines, a normal royalty rate is to be phased in over a certain period in order to recognize the developer's front-end expenditures. The overall review and approval procedure for coal developments is highlighted, and includes submission of cost-benefit and social impact analyses, consideration of Alberta's coal requirements if any out-of-province coal exports are intended, and the intent to make maximum use of Alberta manpower, goods and service in all aspects of coal exploration and development.

14885 (EMR/E—1976, pp 77-80) **Coal power for electric utilities.** Kirkpatrick, L.F. (Nova Scotia Power Corp.). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

A review is presented of provincial policies and capabilities with respect to power generation by coal-fired plants. Highlights of this review include a major commitment to new coal-fired plants in Nova Scotia; increased demand for coal in Ontario, with a greater percentage of this demand to come from Canadian sources; the increasing use of indigenous coal resources in Alberta for power generation in that province; and the importance of government policies in determining coal use in British Columbia, which has large coal reserves but which generates 90% of its power hydroelectrically. Implications of these findings for the future of coal in power generation are discussed. Recommendations are made for putting more emphasis on coal in Canada's national energy policy.

14886 (EMR/E—1976, pp 73-75) **Coal in the energy picture.** Taylor, J.M. (PanCanadian Petroleum Ltd.). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—92127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

The energy supply situation in Canada is reviewed starting with examination of hydrocarbon-based resources: the tar sands, natural gas, frontier developments, and conventional oil. It is shown that tar sands and frontier developments are constrained by high costs, natural gas is abundant but development is threatened by lower prices, and an improved economic and political climate has resulted in increased oil exploration activity in Alberta and British Columbia. Coal is then discussed as a large potential energy source. After noting that Alberta's new coal policy may constrain new coal developments for environmental reasons, a number of possible routes for such developments are mentioned. One is the use of coal to produce low Btu gas, either for use as a fuel or as a feedstock to make oil, methanol and ammonia. Production of such gas requires long lead times and large capital expenditures, and government policies are not necessarily favorable to low Btu gas plants. Construction of such plants can be justified on economic grounds, and use of such gas in petrochemical or fertilizer plants could free natural gas for export. However, the incentive to consider coal gas as an energy source is low in Alberta because of the low price and ready availability of natural gas; if coal gas is to be a realistic alternative, an appropriate national energy policy, possibly including financial incentives, would be required.

14887 (EMR/E—1976, pp 47-49) **British Columbia - progress report on coal policy.** Fyles, J.T. (Ministry of Mines and Petroleum Resources, British Columbia). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

Aspects of a technical review of British Columbia coal resources are discussed with reference to their implications for future provincial coal policy. As part of this review, an inventory of reserves and resources was compiled. It was shown that reserves are adequate to meet foreseeable demands for metallurgical coal into the next century, and that the Hat Creek deposit, the province's main reserve of thermal coal, is large enough to permit development of a major long-term power installation dependent on its use. Policy implications following from this inventory include the encouragement of new metallurgical coal mines, the proper management of coal exports in order to maximize benefits to British Columbia and Canada, and further research into coal resources. In order to minimize the environmental impact of new coal mines, a set of guidelines were published and circulated; progress on implementation of these guidelines and feedback from the coal industry is reported. 2 refs.

14888 (EMR/E—1976, pp 39-45) **The development of Saskatchewan's coal policy.** Whelan, E. (Ministry of Mineral Resources, Saskatchewan). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

Saskatchewan's basic energy resource policy is outlined and some developments in coal-related aspects of this policy are de-

scribed. A study was undertaken to determine the extent of the province's coal deposits, and it was seen that reserves located in the Ravenscrag Formation near the US border could amount to 5.5 billion tons of economically recoverable coal. A moratorium was put on new coal permits in order to keep open any future options on provincial coal development. A Coal Conservation Act was proclaimed, which enables regulation of plans and programs for coal development, licensing of mining operations, and establishment of a Coal Conservation Board. The future role of coal in the provincial energy mix is then predicted. It is felt that coal will become a more important energy source as conventional oil supplies decline, and that coal will have importance in power generation, synthetic fuel production, and in any industrial use which requires coal for its carbon content.

14889 (EMR/E—1976, pp 35-37) **A coal policy for Nova Scotia.** Gillis, W. (Ministry of Mines, Nova Scotia). 1976. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

As part of a review of alternative energy sources for Nova Scotia, an assessment was made of coal as the major short-term alternative to costly and insecure oil supplies. A summary is presented of an inventory of coal resources of the five major coal basins in the province. The Sydney deposit, which outcrops on the coast and dips seaward, is the most important of these and has estimated proven reserves of 400 million tons. Policies intended to develop the province's coal resources are outlined; at present, Nova Scotia is committed to the use of coal for future power generation and expects that new coal developments will contribute to attain this objective. 1 fig.

14890 (EMR/E—1976, pp 27-31) **The energy challenge and the role of coal.** Lantzki, V. (International Energy Agency). 1976. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

The key elements of the energy challenge faced by the industrialized democracies are identified in this paper as an increased need for conserving energy use, notably oil, and the necessity for increasing production of indigenous energy sources. With respect to the latter element, among the indigenous sources that have realistic possibilities for significantly increased production is coal. A discussion of the role that coal can play as a credible energy source is presented, in the context of coordinated energy-related policy efforts among members of the International Energy Agency (IEA). Since expansion of coal production on a substantial scale depends on the growth of coal-fired electric power generation, measures to ensure the maximum possible use of coal in power generation are recommended. In addition, policies will be needed to create long-term security for the world coal trade, as well as policies favoring coal utilization. An international strategy to encourage coal utilization would provide a foundation for large scale coal development and would benefit producer countries such as the USA and Canada. Specific actions that could be taken by the IEA are outlined. These include cooperative research and development activities related to coal, using financial incentives to promote coal-fired power plants, establish common codes or guidelines on the mining and use of coal, easing import/export restrictions on coal, and assistance of underdeveloped countries to develop their coal resources, transport infrastructures and coal utilization.

14891 (EMR/E—1976) **Twenty-eighth Canadian conference on coal.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Energy Sector). 1976. 123p. (CONF-8609466—; CE—02127). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34 CAN per page, $3.40 CAN minimum.

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

A conference was held in Canada to consider various aspects of the coal industry. Papers were presented on coal supply and demand, the role of coal in the national mix of energy sources, provincial coal policies, the demand for coal in various industrial sectors, coal resource development, and coal transportation. Separate abstracts have been prepared for thirteen papers from this conference.

14892 (GAO/NSIAD—88-89BR) **International energy agency.** (General Accounting Office, Washington, DC (USA). National Security and International Affairs Div.). 1988. 35p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The International Energy Agency's emergency oil sharing system is designed to enable member nations to share oil supplied during an oil supply disruption equal to or exceeding 7 percent or more of members' oil supplies. However, participation could have anticompetitive consequences and under U.S. antitrust laws could result in suits against U.S. companies. To ensure participation of major U.S. oil companies, legislation provides a statutory defense against any civil or criminal suit brought under federal or state antitrust laws for some actions. This report describes efforts to expand the antitrust and breach of contract defenses for oil company supply transactions during an oil emergency and to resolve the problem of foreign blockage of information critical to U.S. antitrust review of oil transactions involving foreign affiliates of U.S. companies.

14893 **Polynuclear aromatic hydrocarbons in the condensed phases associated with coal gasification.** Bradley, A.A.; Ferrell, J.K.; Felder, R.M. (Dept. of Chemical Engineering, North Carolina State Univ., Raleigh, NC (US));. pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

This paper deals with the fate of polynuclear aromatic hydrocarbons (PAHs) in the condensed phases associated with a coal gasification-gas cleaning pilot plant facility located on the North Carolina State University campus. Data are presented for the gasification of a New Mexico subbituminous coal, a North Carolina peat and a lignite coal. The pilot plant consists of a fluidized bed gasifier, a gas cleaning system for removing particulate, condensable, and soluble materials (PCS system) from the raw gasifier product gas, and an acid gas removal system (AGRS). The AGRS consists of an absorber, flash tank, and stripper, and employs refrigerated methanol as a solvent. The analyses for the PAHs were performed by glass capillary column gas chromatography and gas chromatography/mass spectroscopy. Preliminary results indicate that the PAH's generated in the gasifier are deposited in the tars at various locations in the PCS system, or are condensed from the gas stream by the water scrubbing operation in the PCS system. Only trace quantities of PAH compounds reach the AGRS, as indicated by analysis of the solvent methanol. The data for the tars and waters associated with this process indicate more nitrogen and oxygen-containing PAHs are generated from the peat than the subbituminous and lignite coals. The lignite coal produces less tar than the other two feeds.

2960 Electric Power

REFER ALSO TO CITATION(S) 14640, 14836, 14874, 14928, 14929, 14998, 15000

14894 (DOE/EI/19801—H2) **Software documentation of the capacity expansion component of the electricity market model: Final report.** (ICF, Inc., Fairfax, VA (USA)). Dec 1988. Contract AC01-87EI19801. 117p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006699/JAW.

The Electricity Market Model (EMM) is designed to simulate electric utility behavior in formulating capacity expansion plans, in determining fuel type consumption patterns, in accumulating total electricity costs and in setting electricity prices. It evolved from the Intermediate Future Forecasting System (IFFS) within which it was one of several modules each of which concentrated on one fuel type. The main body of this document consists of de-

tailed descriptions of each subroutine used in making capacity expansion decisions. The document reads in the order of the calling sequence of subroutines from the top down, however, an alphabetically ordered index is provided so that it can be used as a reference manual as well. For a complete understanding of the capacity expansion model it is recommended that the reader begin with the subroutine BECHRT, then proceed to LOADIT, COSTTB and FAREAT. These four subroutines give a reasonably complete understanding of how the expansion plan to meet a specific future year's demand is devised. Then the reader should proceed to ELBLDG in order to understand how a series of such expansion plans are combined into an overall plan for a given year and region. The remaining subroutines are key to understanding data availability and structures. 17 figs.

14895 **(DOE/EIA—0397(88/3Q)) Electric power quarterly, July--September 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Jan 1989. 300p. NTIS, PC A13 - GPO - OSTI. Order Number DE89006892/JAW.

The Electric Power Quarterly (EPQ) is prepared by the Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels; Energy Information Administration (EIA). The EPQ is designed to provide energy decisionmakers with accurate and timely generation and fuel cost and quality information on a plant-by-plant basis. This publication is designed for applications by electric utilities, fuel suppliers, consumers, educational institutions, and government in recognition of the importance of energy planning. The EPQ presents monthly summaries of electric utility statistics at the national, Census division, state, company, and plant levels on the following subjects: quantity of fuel; cost of fuel; quality of fuel; net generation; fuel consumption, and fuel stocks. In addition, the EPQ presents a quarterly summary of reported major disturbances and unusual occurrences. 1 fig., 15 tabs.

14896 **(DOE/EIA—0437(87)) Financial statistics of selected electric utilities, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 26 Jan 1989. 1129p. NTIS, PC A99/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89006957/JAW.

The Financial Statistics of Selected Electric Utilities is prepared by the Data Systems Branch; Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels; Energy Information Administration. The US electric power industry is a combination of private, public, cooperative, and Federal utilities. Private or investor-owned electric utilities account for over three-fourths of the revenues and sales in the industry, historically serving the large consolidated markets. Public, cooperative, and Federal electric utilities play a secondary role. Public and cooperative electric utilities are usually small, and usually are financed through governmental and/or nonprofit financial organizations. They are given preference in the purchase of less expensive Federal power. 5 figs., 65 tabs.

14897 **(DOE/IE—0013) Electric power supply and demand for the contiguous United States, 1988-1997: Staff report.** (USDOE Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness, Washington, DC. Office of the Deputy Assistant Secretary for Energy Emergencies). Jan 1989. 154p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006816/JAW.

This report reviews the bulk electric power supply and demand situation for the contiguous United States as projected for 1988-- 1997 in the April 1, 1988, IE-411 reports of the nine Regional Electric Reliability Councils. These annual reports are regarded as embodying the consensus of US electric utilities concerning the parameters of US electric power supply and demand for the next decade. But consensus does not eliminate the uncertainty associated with projection of future events. The conclusions of this report are based on analysis of the data as reported. It is assumed that actual conditions will correspond to the forecasts, although exact correspondence year-by-year is unlikely. Tabulations and data are included for all Regions and Councils. In addition, major topics related to the planning and operation of power systems are discussed briefly. 4 figs., 44 tabs.

14898 **(DOE/PETC/TR—89/1) Electric utility coal conversion market analysis.** (USDOE Pittsburgh Energy Technology Center, PA). Oct 1988. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003549/JAW.

To address the needs for and benefits of additional R and D directed at converting existing electric utility boilers to coal, the Pittsburgh Energy Technology Center has initiated a series of technical and market analyses. The technical analyses are ongoing. Results obtained to date indicate that further R and D offers the prospect of significantly advancing the technology base and removing technical, economic, and environmental barriers to coal conversion. Concurrent with its technical and engineering analyses, PETC conducted a market analysis covering the potential need for advanced coal retrofit technology within the electric utility sector. The results of this market analysis are presented herein. 10 refs., 4 figs., 10 tabs.

14899 (EMR—9008, pp 31) **Direct control of residential electric consumption: an experimental assessment of customer acceptance.** Dyer, R.F. (Washington Univ., DC). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

A review of existing literature on direct, peak load control experiments conducted by individual utilities, industry institutes, and regulatory bodies is presented, including a critical examination of studies conducted by utilities in Arkansas, Georgia, Massachusetts and Ohio. Preliminary conclusions from the literature review indicated a generally positive attitude by study participants toward direct load control. An experiment was then conducted investigating attitudes towards three types of mechanical control treatments: radio control of air conditioning and water heating; radio control of air conditioning only; and control of water heating only when the air conditioning was operating. Customer acceptance measurements were taken regarding awareness of controls, discomfort experienced, shortages experienced, inconvenience attributed to controls, and attitudes towards the utility's control system. The general trend suggested by the survey data is that almost minimal levels of intrusiveness were experienced and that attitudes toward the control system were strongly positive. Another notable finding was that intentions to participate in future load control programs were uniformly high across the test groups. 11 refs., 3 figs., 12 tabs.

14900 (EMR—9008, pp 20) **Satisfaction, knowledge and commitment of customers on a mandatory participation time-of-day electricity pricing experiment.** Heberlein, T.A.; Linz, D.; Ortiz, B.P. (Univ. of Wisconsin, Madison, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

Customer satisfaction, commitment and knowledge were measured in a mandatory participation time-of-day electricity pricing experiment in Wisconsin. Three price ratios were fully crossed with three peak lengths; the peak period ranged from 6 to 12 h. Magnetic tape meters were used to monitor a sample of households, and attitudes were surveyed by means of questionnaires. The findings indicate that even with on- to off-peak price ratios as high as 8:1, customer satisfaction remains high. Customers with 6-hour peaks were less satisfied and customers with 2:1 price ratios were less committed to shifting under the rates than customers in other treatments. Customers were highly aware that they were being billed on time-of-day rates, but were less than completely knowledgeable about pricing details. The experiment covered a 3-year period, and examination of customers' persistence in energy saving behavior showed that most customers seemed to have maintained a constant level of effort to avoid electricity usage during peak periods. 24 refs., 2 figs., 6 tabs.

14901 (EMR—9008, pp 24) **A progressive rate structure for household electricity consumption.** van Helden, G.J.; Weistra, S.S. (Univ. of Groningen, NL). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper intends to show how the rate structure of electricity can contribute to a policy of energy saving. More specifically, the relevance of a progressive rate structure is considered in relation to household electricity consumption. Such a rate structure is characterized by the fact that the price per unit increases as the yearly household consumption increases. Four rate structures are examined: a proportional rate structure with a constant fixed charge; a progressive step tariff with a constant fixed charge for every consumption block; a progressive step tariff with degressive fixed charges; and a progressive block tariff with a constant fixed charge. Analysis of the effects of these kinds of structures on electricity consumption is made in accordance with tariffs prevailing in the Netherlands in 1978, and use was made of other Dutch studies involving household interviews and econometrics. A number of hypotheses on price elasticity were considered and empirical research was done only on the progressive block tariff. It was concluded that a progressive rate structure always leads to a decrease of consumption in comparison with the current proportional tariffs. This decrease varies from 1-6% and appears to increase as the difference in prices between the consumption blocks increase and as the number of tariff blocks increases. The effects of a progressive tariff on energy savings will be considerably greater if the fixed charge, or parts thereof, is included in the kWh prices. 18 refs., 6 tabs.

14902 (EMR—9008, pp 23) **Electricity consumption by the elderly policy implications of income unrelated use levels.** Warriner, G.K. (Univ. of Wisconsin, Madison, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

A multivariate, causal analysis paying special attention to the income-related effects upon residential electricity consumption by the elderly was undertaken. Data for this study were collected in conjunction with a time-of-use rate demonstration project in Wisconsin. Data on demographic characteristics, monthly electricity consumption levels, and average monthly electric bills were collected. It was seen that the elderly use less electricity on the average, and as a result, pay lower monthly bills per household. However, they pay proportionately more of their income on electricity than non-elderly households, and use more of their electricity for essential needs. Since their homes contain fewer members, the elderly use proportionately more electricity per capita. They also own fewer appliances than other households. Regression analyses indicated that being elderly, in itself, is not an influence on electricity consumption; the main factors which contribute to the elderly's reduced consumption levels are that they have fewer household members and appliances. Other statistically significant factors are size of home and income. Using models to predict the elderly's electric bill, it was seen that the least important factor contributing to the size of their bills was income. It appears at best that the elderly are not forced to consume less electricity than other groups due to economic deprivation; neither does it appear that improvements in their economic situation will lead to sizeable increases in consumption. Implications of the study findings for policies to assist the elderly are discussed. 31 refs., 1 fig., 7 tabs.

14903 (EMR—9008, pp 18) **Policy applications for utility residential consumer surveys, an industry example.** Spencer, R.H., Jr. (Puget Sound Power & Light Co., Bellevue, WA, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper reviews many of the advantages associated with electric utility data collection programs, including the techniques which can be applied to minimize survey-related errors and policy applications of analytical results. The main focus is on issues ralated to applied rather than to theoretical research of energy consumption behavior. Information in this paper comes mainly from experiences at a Seattle utility, which conducted surveys to develop a residential customer data base which might then be applied in rate, conservation, and forecasting policy analyses. Pretest, sampling, and response analysis procedures are described. Data were evaluated to provide such information as the saturation of major electrical applicances, the correlation between electrically heated homes and degree of home insulation, the annual electricity consumption of owner-occupied dwellings compared to that of renter-occupied dwellings, and the relation between appliance purchases and length of residency. 9 refs., 1 fig., 3 tabs.

14904 (EMR—9008, pp 17) **Consumer acceptance of centralized control of electrical energy usage.** Corney, W.J.; Nixon, J.E.; Yantis, B. (Univ. of Nevada, Las Vegas, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

For public utilities, energy management provides an alternative to the purchase of expensive peak generation equipment. The research presented in this paper provides information regarding the practical viability of remote control of selected household power-consuming devices during peak load periods. An experimental program was conducted wherein remote control devices were installed in selected households to allow the utility to turn off air conditioners for certain periods each half-hour during the afternoon. Attitudes on energy problems and to the energy management system were surveyed. Results show that a substantial proportion of the total residential customers of the utility could be expected to volunteer their participation in such an energy management program if it were offered to be implemented for all customers. In examining the relation between participants and energy attitudes, it appears that with an increase in advertising and word-of-mouth communication about the program, a substantial increase in participation could be expected. For long term success of the program, however, it appears that energy conservation alone may not be enough incentive to keep a customer staying in the program. With regard to the performance of the energy management system, air conditioning control did not appear to affect the actual comfort level. Consumer attitudes toward the effect of the control device on their air conditioning unit was also favorable. 18 refs., 8 tabs.

14905 **(EPRI-EL—5807-SR) Transformer overload and bubble evolution: Proceedings.** Addis, G.; Lindgren, S. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 173p. (CONF-871290—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88011930/JAW.

From Transformer overload and bubble evolution; Palo Alto, CA, USA (8 Dec 1987).

The EPRI workshop on Transformer Overload Characteristics and Bubble Evolution was held to review the findings of investigations over the past 7-8 years to determine whether enough information is now available for utilities to establish safe loading practices. Sixteen papers were presented, including a utility review, physical and dielectric effects of gas and bubble formation from cellulose insulated transformers, transformer life characteristics, gas bubble studies and impulse test on distribution transformers, mathematical modeling of bubble evolution, transformer overload characteristics, variation of PD-strength for oil-paper insulation, survey on maximum safe operating hot spot temperature, and overload management. The meeting concluded with a general discussion covering the existing state of knowledge and the need for additional research. Sixteen papers have been cataloged separately.

14906 (EPRI-EM—5846, pp 4.1-4.22) **Creating viable utility conservation/load management programs.** Hirst, E. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Energy-efficiency programs can be designed to meet different objectives: reduce overall electricity use, modify annual, seasonal, or daily load shape; obtain cost-effective energy "resources; " delay need for additional generation or T and D investments; improve relations with customers; promote economic development; respond to regulatory requirements; respond to activities undertaken by competitors (e.g., natural gas utilities); reduce uncertainty about future load growth; and/or reduce the adverse environmental effects of electricity production. Program planning, analysis, and evaluation are essential to achieving these objectives. 26 refs., 6 figs., 1 tab.

14907 (EPRI-EM—5846, pp 5.1-5.11) **Developing a least-cost strategy for utilities.** Naill, R.F. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Least-Cost planning has become an important concept for utilities. Many Public Service Commissions have adopted this concept (for example, Illinois, Nevada, California, Florida and Texas). However, utilities and Commissions often have different interpretations of what a "Least-Cost plan" involves. Applied Energy Services, Inc. (AES) has a unique perspective on Least-Cost planning, since the principals of AES invented the term in 1979. Since 1981 AES has been working with clients to apply the Least-Cost concept to utility planning. This paper describes examples of how these principles were applied to two utilities{endash}Northeast Utilities (based in Berlin, Connecticut) and the Public Service Company of New Hampshire (Manchester, New Hampshire).

14908 (EPRI-EM—5846, pp 7.1-7.17) **Operationalizing least-cost planning concepts: A Wisconsin perspective.** Landgren, D.A. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Wisconsin Electric (WE) has been developing a formalized approach to integrated planning (referred to in some quarters as least-cost planning) since mid-1985. In addition, four utilities in the State of Wisconsin have joined together to develop these concepts among themselves. The organizational needs required to implement integrated planning and some of the problems that were resolved are discussed below. The concepts of integrated planning are briefly reviewed and the methods WE is using to measure these concepts are discussed. These include analytic tools to project end-use consumption, tools to perform cost/benefit analyses and procedures to identify demand- and supply-side options. Data requirements for integrated planning are intense. These needs are identified. Data availability is discussed along with a review of efforts within WE and the State of Wisconsin to obtain data. The procedure that WE uses to evaluate options and determine if they are to be included in a least-cost resource plan is presented. Included is a discussion of uncertainty within the plan. 1 fig., 5 tabs.

14909 (EPRI-EM—5846, pp 8.1-8.10) **Operationalizing least-cost planning: Where there's a will there's a way.** Mendl, J.E. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

The Wisconsin Public Service Commission has been engaged in long- range planning review and development since the 1975 passage of Wisconsin's Power Plant Siting Law. The nature of the planning work, both at the utilities and the commission, has evolved considerably over the past decade. The forecasting and analysis methods have gotten more sophisticated, and the issues have shifted from large-scale capacity additions to renewable resource additions and demand-side programs. Wisconsin has evolved to its current practice of least-cost integrated planning as defined in our August 1986 order which describes the objectives and characteristics of utility planning. This paper offers some insights and observations about putting into action the concepts of least-cost integrated planning.

14910 (EPRI-EM—5846, pp 9.1-9.14) **Michigan: A case study in operationalizing LCP [Least Cost Planning].** Black, T.R. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

I am grateful to the sponsors of this symposium for providing the opportunity to share perspectives on Least Cost Planning (LCP) and the relate the manner in which the State of Michigan has begun to operationalize least-cost planning concepts. I hope that you will have a chance to provide feedback on the approach we have taken. We will cover four basic items in this presentation: (1) note some of the key events that gave rise to Michigan's movement into least-cost planning; (2) summarize our three-part approach to institutionalizing and supporting least-cost planning: (3) discuss in some detail the project which constitutes the foundation of our LCP initiative (noting how we have addressed some of the fundamental questions which are at issue in the symposium); and (4) provide a brief status report on where we stand in operationalizing our least cost planning thrust. A number of significant events, many of them common across the country, along with some rather unique political dynamics have led Michigan utilities, regulators and policy-makers toward a focus on least-cost planning for electricity resources. 2 figs.

14911 (EPRI-EM—5846, pp 10.1-10.11) **Demand-side management: Implications for planning and operations.** Smith, W.M.; Gellings, C.W. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Demand-side management is the planning and implementation of utility activities designed to influence customer use of electricity in ways that will produce desired changes in the utility's load. Utility programs falling under the umbrella of demand-side management include: load management, new uses, strategic conservation, electrification, customer generation, and adjustments in market share. DSM includes only those activities that involve a deliberate active intervention by the utility in the market place so as to alter its load shape. DSM encompasses planning, evaluation, implementation, and monitoring of activities selected from among a wide variety of technical alternatives. this wide range of alternatives offers significant benefits to utilities that incorporate DSM into the overall planning process. This report will examine how DSM fits into that process, describe the practical application of DSM to the utility environment, and assess some of the prominent implications of DSM for utility operations.

14912 (EPRI-EM—5846, pp 11.1-11.2) **Least cost planning under uncertainty.** Rosput, P.G. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Supply-side issues are inseparable from demand forecast issues. Uncertainty, inherent in forecasting the future, has major implications for least cost planning; The costs of forecasts being wrong must be considered in the development of strategies for meeting future energy demands. A utility's resource plan results from the examination of three crucial ingredients: the load forecast; the costs of various resource options; and forecasts of marginal costs. There is on thing that can be said for certain about these forecasts{endash}they will be wrong.

14913 (EPRI-EM—5846, pp 13.1-13.12) **Integrated resource planning issues.** Hirst, E. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Integrated resource planning (IRP), sometimes called Least-Cost Utility Planning (LCUP), is currently a popular idea. IRP is also a very important concept, but one that is quite difficult to implement. This paper discusses ny views on the key components of the IRP process and presents a brief progress report on the IRP activities at Puget Power. 4 figs., 1 tab.

14914 (EPRI-EM—5846, pp 14.1-14.30) **Moving towards integrated resource planning: Understanding the theory and practice of least-cost planning and demand-side management.** Gellings, C.W.; Chamberlin, J.H. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Long term planning has long been a critical activity for the electric utility. This is due in large part to the size and lead times of central station power plants, and to the need to anticipate the transmission and distribution systems to support community growth. The strategic importance of electricity to the national economy, rising capital costs of generating plants, wider availability of energy efficient technologies, and greater choices of fuel suppliers have made electricity planning an important topic of public scrutiny. Traditional electric utility planning has consisted largely of matching expected customer load growth with the right kind of "supply-side" generating capacity or energy purchases. In recent years there has been emergence of interest in planning methods which focus on alternatives to supply-side options. Two such approaches, Least-Cost Planning and Demand-Side Management (DSM), both address opportunities to modify the ways in which energy (especially electricity) is used to reduce the need for new generation sources. The term least-cost planning is sometimes used to describe the idea of balancing the mix of supply-side and demand-site alternatives to meet society's energy needs at the "least-cost." A more descriptive and accurate term for this balancing is Integrated Resource Planning. 13 refs.

14915 (EPRI-EM—5846, pp 15.1-15.8) **The Northwest Power Planning Council and its strategies for least-cost energy planning.** Litchfield, J. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Because of the current regional power surplus, the Northwest Power Plan has not been tested under fire. That will come when the region begins a major acquisition program. However, one result is already clear. Electrical power planning in the Pacific Northwest now takes place in an open public debate among a variety of interested parties. There is a growing exchange of information and an increasing reliance on interagency cooperation. The days of power planning in private board rooms are over.

14916 (EPRI-EM—5846, pp 1.1-1.15) **Least-cost energy planning: Past, present, and future.** Smith, V.L. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

The recurrent incentive failures of rate of return regulation in past experience strongly suggest that the achievement of a least-cost discipline by regulatory planning is an unattainable goal. The technological development of long distance transmission, and of alternative sources of power in networks, has spawned a number of market institutions outside the state regulatory apparatus: long-term contract sales; spot power exchange; contract power pooling; shared facility ownership in generation and transmission; and economic dispatch. The prior existence of these institutions combined with the current surplus of power has caused increasing competition in the electric power market. This has brought market forces to bear on electric power rates, and has catalyzed the movement to deregulate generators from state authority, and to restructure utility assets. By encouraging this movement the regulatory commissions can further the achievement of least-cost outcomes through the discipline that markets exert on prices, and thence on costs. By activist counterproposals to the utilities, the commissions can influence this restructuring of assets so that some of the capital gains inherent in the restructuring process are shared with consumers in the form of rate reductions, or of offsets to rate increases. Finally, for the more distant future, the antitrust supervised, competitively ruled joint venture has promising possibilities for the deregulation of transmission and perhaps even distribution. 3 refs.

14917 (EPRI-EM—5846, pp 2.1-2.28) **Perspectives and issues in least-cost planning: Toward a standard practice approach.** Woychik, E.C. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

This paper defines perspectives and issues in least-cost planning with a view toward establishment of a standard practice for least- cost planning which puts supply and demand options on a common basis, while explicitly considering the irreducible uncertainties we face. Section II presents perspectives in last-cost planning and supports the use of a utility perspective for resource plan integration under regulation. Section III discusses energy price signals and unbundling of utility services. Value-of-service principles in resource planning are suggested to equate value and costs. Section IV outlines a set of issues in the economic evaluation of resources planning and the treatment of uncertainty. The paper concludes that least-cost resource planning and unbundling of utility services are essential to maintain utility viability in the face of increasing competition. 9 refs.

14918 (EPRI-EM—5846, pp 3.1-3.3) **Note on alternative regulatory treatments of utility investments.** Shea, K. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

In this era of a mixed-market supply of energy generation, there are qualifying facilities and cogeneration alternatives compensated at a market based "avoided cost," and traditional utility generation (baseload, intermediate, and peaking units) compensated at the utility's authorized rate of return, there needs to be consideration given to ratemaking treatments that will provide incentives to utilities to take the risk of investing in a (baseload) project that is expected to provide significant fuel savings.

14919 (EPRI-EM—5846, pp 6.1-6.7) **Competitive markets and electricity planning: An integrated least-cost policy.** Markowitz, P. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

Least-Cost electrical strategies require future electrical needs are met through the optimum mix of supply-side and demand-side resources at the least total cost to utilities and ratepayers. The merging of two notable trends, competition in providing electrical services and least-cost energy planning, offers a promising approach to the effective implementation of least-cost strategies. Competition in providing electrical services has stimulated alternative resource development, and in some cases, has created exciting opportunities for acquiring resources in a least-cost manner. However, a truly competitive market will require that demand- and supply-side resources can compete on an equal basis, but conservation is already at a serious disadvantage. Least-cost energy planning laws and regulations have been adopted by over half a dozen states nationwide. The least-cost planning process requires utilities to identify the economic potential for all resource options, including energy efficiency improvements, load management, cogeneration, and renewable energy sources. Utilities must then rank these options according to their relative cost-effectiveness, and invest in the cheapest options

for meeting electrical needs. A merging of these two approaches holds great promise.

14920 (EPRI-EM—5846, pp 12.1-12.6) **Competition and a least cost energy strategy.** Hamrin, J. Jun 1988. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88012291/JAW. (CONF-8702145—).

From Least-cost energy planning in the midwest: a symposium; Chicago, IL, USA (10 Feb 1987).

In some cases, "competition" is being used to describe a utility transaction in which utility shareholders are receiving an unregulated profit on excess power sold to other utilities while ratepayers pay all the capital and operating and maintenance (O&M) costs thus guaranteeing against losses. In other cases "competition" describes a condition where all nonutility players compete with each other for a piece of the pie while the utility continues its cost-plus, business as usual. In still other cases "competition" is used to describe a condition where the utility has used its monopoly position to ensure there is nobody else on the playing field except the home team. Another definition of "competition" refers to a force between players which causes everyone to become as efficient as possible acting in accordance with certain fixed rules. Usually, however, the term "competition" implies opponents more or less evenly matched.

14921 **(NP—9770220) Public electricity supply in the Federal Republic of Germany in 1987 (including Berlin/West).** (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (Germany, F.R.)). 1988. 59p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770220/JAW.

After a brief view at the most important characteristic data of the electricity industry of the Federal Republic of Germany for the years 1986 and 1987, the most important results of this economical branch in 1987 are reported on; in doing this, power generation, power consumption and power distribution are especially emphasized. Many multicolour diagrams make the numbers clearer. The annex contains numerous tables; most of the comparisons with previous years go back until 1977.

14922 **A view on the commercial readiness of new technology in the electric utility industry.** Reddoch, T.W.; Taylor, R.W.; Miles, W.T. (Electrotek Concepts, Inc., Knoxville, TN (US)); DeSteese, J.G.; Hurwitch, J.W. (Battelle-Pacific Northwest Lab., Richland, WA (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

The electric utility industry is undergoing major changes in all aspects of its business. The traditional approaches to electricity supply, pricing, regulation, and finance have come under intense scrutiny. Technology innovations are emerging which offer the potential for providing improved flexibility, adaptability, and the possibility of tailoring electric service more closely to customer needs. (The commercial readiness of these technologies ranges from prototype to mature.) These trends include new generation options (renewables, storage, cogeneration, and more modular conventional units) distribution automation, end-use load management, power electronics, and advanced computer-based systems for information management. These technology trends may also imply significant changes in utility business practices which may require industry infrastructure changes in order to achieve successful implementation. This paper describes these trends, their underlying factors, their commercial readiness, and their likely role and presentation into electric utility systems.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 14895, 15043, 15073

14923 **(NP—9770221) Data on the development of the West German energy industry in 1987.** (Bundesministerium fuer Wirtschaft, Bonn (Germany, F.R.)). Nov 1988. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770221/JAW.

An introducing survey of international and national energy policies in 1987 as well as of the energy supply situation in the Federal Republic of Germany is followed by statistics, tables and diagrams containing significant data on energy economics. In particular, they refer to the primary energy balance, structure of energy consumption, import and export of energy supplies and the development on the hard coal, brown coal, mineral oil, electricity and gas market (reserves, application, prices). The year under review, 1987, is related to and compared with previous years reaching back as far as 1970.

14924 **(UCID—18991-87) California energy flow in 1987.** Borg, I.Y.; Briggs, C.K. (Lawrence Livermore National Lab., CA (USA)). 13 Jan 1989. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006805/JAW.

California is noteworthy because of its diversity of energy supply and its proclivity to change and experiment in all matters relating to energy use and development. Overall energy use in the state increased 6% spread over almost all end-use sectors. The increase reflected a colder year than 1986 and a large population increase. On the supply side, the most impressive change in meeting demand was a substantial (23%) increase in the use of natural gas, particularly for power production and in the industrial sector. The increase was fostered by drought conditions that limited hydropower, by the increased availability of out-of-state supplies, and by changes in regulations governing gas transmissions. The number of cogenerators and self-generators grew faster than in the nation as a whole. The amount of power sold to the utilities by this group was double the amount sold in 1985, posing problems to utilities and regulatory agencies alike. Alternate sources of energy continued to grow. The state's windfarms and geothermal installations are the largest in the world. The state sponsored methanol program moved ahead with the introduction of flexible fueled automobiles into the state's fleet and installation of a large number of service stations selling the fuel. Nonetheless, California's energy picture is dominated by the use of petroleum and natural gas, the bulk of which are imported. 31 refs., 3 figs., 7 tabs.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 14496, 14635

14925 **(EC—8102) Potential benefits and methods of stimulating alternative energy developments.** Baker, G.C. (Environment Canada, Ottawa, Ontario). 1981. 51p. (CE—02282). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study was undertaken to examine the extent to which alternative energy projects in Canada might require, and deserve, stimulation through public policy. A second objective was to explore the degree of stimulus provided by various kinds of incentives under various conditions. The basis of evaluation distinguishes between those benefits and costs commonly reflected in the books of an undertaking (internal), and those not so reflected but nevertheless impinging on society (external); of the external costs, only the subsidy on oil imports has been taken into account. By means of simple mathematical models, it is shown that high interest rates and long project lives tend to make financial feasibility more difficult to attain. The effects of tax and depreciation rates, equity ratio and various forms of incentive subsidy are also explored by means of models. Tax and depreciation rates affect only taxable projects. Tax reductions transfer benefits from the public treasury to the corporate one, but depreciation is found to have little effect on long-life projects. Of all the measures considered, incentives to encourage equity investment appear to offer the best combination of cost-effectiveness and wide applicability. The conditions for marginal economic and financial feasibility are found to coincide at equity ratios of 25-50%, depending on the state of other project variables. Examples of various alternative energy projects are given. In all cases, it is found that if a portion of the external benefit due to reduced oil consumption were internalized by means of incentives, the effect would be to render the project economically and financially viable, or substantially so. 12 refs., 8 figs., 5 tabs.

14926 (EMR—ER80-8F, pp 150-157) **Prospects for biomass in Canada.** Pnevmaticos, S.M.; Hollins, J. 1980. (In French). CAMMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

Biomass represents 3.5% of total primary energy demand in Canada, 95% of this figure representing conversion of wastes produced by the forest industry. This percentage could be increased, however, since biomass offers great potential as an energy source. Significant present resources in Canada include wood wastes, agricultural waste, municipal solid waste, and peat; future possibilities include crops from energy plantations. A number of biomass conversion processes are outlined which are in various stages of development, including combustion, anaerobic digestion, gasification, and liquefaction. The energy forms resulting from such conversion can then be converted into the main forms of utilizable energy: techniques used for these processes are generally known, but the coupling of the fuel with the conversion technique needs improvement. Biomass energy in Canada is envisaged to be developed in three stages: in the short term, using biomass waste at their sites of production; in the medium term (to the year 2000), implementing processes which assume the transport of biomass to a conversion facility, e.g. production of alcohol fuels; and in the long term, establishing biomass plantations and recovery of hydrogen or hydrocarbons from plants. A number of federal programs intended to encourage these developments are summarized, including the ENFOR forest energy program and the DRECT energy and resource conservation program. It is felt that it would be realistic to double, in the next 10 years, the utilization of wood wastes in the forest industry; in the long term, the contribution of biomass to the total energy supply could attain 10-20%, thanks to the use of energy plantations. 1 fig., 1 tab.

14927 (EMR—ER80-8F, pp 71-76) **Alcohol fuels in the United States: present situation and prospects.** Blum, E. 1980. (In French). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

A brief history of alcohol fuel use in the USA introduces this report. Traditional low cost and high availability of gasoline has meant little use of alcohol as a transport fuel; however, recent developments have brought about an increase in fuel ethanol production from biomass. This development has been stimulated by the rapid rise in oil prices, the continuing agricultural surplus (especially of corn), environmental concerns, and pressure from public interest groups. Given this situation, the federal government has initiated a number of programs to promote the use of ethanol fuels. Some programs outlined in this report include tax credits for utilization of biomass-derived alcohol and financial incentives for alcohol production. An Office of Alcohol Fuels has also been created to promote research and development activities. Thanks to such programs, alcohol production has increased and could attain 500 million gal/y by the end of 1981. Current production costs are estimated at $1.20-1.40/gal.

14928 (EMR/CRE—8012, pp 39-49) **Some comments on the Tennessee Valley Authority's solar heating program.** Koster, F. (Tennessee Valley Authority). 1980. Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). (CONF-8005266—; CE—02255).

From Potential impacts of the deployment of solar heating on electrical utilities workshop; Ottawa, Canada (12 May 1980).

The programs of the Tennessee Valley Authority to promote solar heating are tailored to replacement of peak electrical demand, notably in the residential sector, where 55% of space heating is provided by electricity. The goal of the Solar Applications Program is to displace the need for 1000 MW of installed capacity by 1990, and the program is coupled to the utility's Conservation Program which aims at displacing 5000 MW capacity. One of the projects in this program, Solar Memphis, installed solar water heaters in Memphis with low-interest financing provided by the utility; to date, 540 systems have been installed, and is very cost effective for both the customer and the utility. A similar program in Nashville set up a capital fund to create a market for solar water heaters, and the utility tested and approved the actual systems, did the marketing, and provided customer financing. Other programs include providing construction financing for well-insulated houses that include passive solar features, sending out energy advisors and retrofitting consultants to households, and promoting proper installation, standardization, and inspection of wood burning stoves.

14929 (EMR/CRE—8012, pp 31-37) **The pros and cons of utility participation in the solar industry - a U.S. perspective.** Sparrow, F.T. (Purdue Univ.). 1980. Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). (CONF-8005266—; CE—02255).

From Potential impacts of the deployment of solar heating on electrical utilities workshop; Ottawa, Canada (12 May 1980).

Involvement of electric utilities in solar energy involves a range of options, including advertising and promotion of solar equipment, financing sales of such equipment, installation and servicing of solar heating systems, and manufacture of solar devices. One argument in favor of such involvement is that the utilities are the entity most aware of the true costs of the backup energy demanded by solar and the true benefits of energy saved by solar. For example, one estimate is that each new home that uses electricity in peak periods requires $10,000 investment in peaking capacity, and utilities could thus use such data to formulate policies to encourage installing such capacity via solar energy provided that an equivalent capacity would cost the utility less than $10,000. In addition, the fact of utility involvement itself has advantages to the commercialization of solar systems: utilites could buy solar equipment in quantity, enabling rationalization of the solar industry, standardization of mass production, and ensuring of quality and performance. Because of their bill-collecting ability, utilities could finance solar investments easily and spread the cost over many customers. Arguments against utility involvement include the possibility that utilities might create an undesirable monopoly in the solar industry, stifle innovation, bring about premature adoption of inferior technology, and squeeze out competitors. A middle position is suggested in which the utility could lend money for solar purchases to ensure that backup power is not used during peak periods.

14930 (EMR/CRE—8012, pp 16-23) **The potential impacts of solar heating on a Canadian utility: the results of some analysis undertaken for Ontario Hydro.** Dautovich, D. (Ontario Hydro). 1980. Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). (CONF-8005266—; CE—02255).

From Potential impacts of the deployment of solar heating on electrical utilities workshop; Ottawa, Canada (12 May 1980).

The views of an Ontario electric utility towards implementation of solar space heating and water heating are presented. Passive solar heating is seen as an effective way to supplement conventional heating sources, thus conserving energy and reducing peak demand. A tentative program to demonstrate passive solar is outlined; this program will involve building 50 passive homes, to determine the cost, energy use, electricity demand shape, and marketability of such homes. The utility has also been investigating solar water heaters also as a potential means for reducing peak demand. A program to install solar water heaters in Ontario homes is outlined; in each phase of this program, the equipment reliability and overall economics are evaluated. 3 tabs.

14931 **(MA—1979) Renewable energy for developing countries: a preliminary assessment of the potential and Canadian capability.** (Middleton Associates, Toronto, Ontario (Canada)). 1979. 200p. (CE—02264). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report examines the energy needs of developing countries, provides a description of renewable energy technologies and clarifies the general status of their applicability to the energy needs of those countries, and compiles information on Canadian capabilities to supply renewable energy technology and expertise. The energy situation in developing countries is characterized by a large

rural sector consuming a relatively small amount of commercial, largely oil-based, energy; critical shortages of traditional energy, notably wood; low levels of conversion efficiency; and low levels of energy consumption. Small scale, decentralized energy systems involving renewable sources offer opportunities to solve such basic energy needs as cooking, water pumping, agricultural processing, refrigeration, and telecommunications. Appropriate technologies undergoing research and development in Canada were screened to select the most promising Canadian capabilities. Options involving hardware were identified as low-head hydro equipment, and photovoltaics for communications and water pumping. Options involving expertise were identified in cooking stove and anaerobic digester design, forest resource management, and energy resource inventory and demand assessment. These capabilities were chosen to meet the requirements of Canadian aid programs, and successful implementation of such programs will involve such elements as support of local technical and manufacturing capabilities, consistent long-term support, and integration of renewable energy with national development objectives. 21 refs., 7 figs., 13 tabs.

14932 **(MA—ER79-1) Solar heating and employment in Canada.** Victor, P.A.; Hathaway, G.; Lubek, J. (Middleton Associates, Toronto, Ontario (Canada)). 1979. 168p. (CE—02194). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The main objective of this study is to examine the overall employment impacts of the developing solar industry in Canada. These impacts are estimated using a variety of assumptions about market penetration and industry location, within the larger context of an economy in difficulty. Seven representative heating systems and applications are described in detail, with estimates of the heat supplied as well as the direct labor and material requirements for each system. These estimates are used as input data to an employment impact simulation model that allows examination of the employment and energy implications of various assumptions about the future of solar heating in Canada. It distinguishes among rates of implementation for each system system in 5 major Canadian regions; output includes estmates for each region to the year 2000 of the energy supplied by solar heating, the cumulative installed collector area, and the amount of direct and indirect labor employed in the solar heating industry. Employment implications of exporting solar collectors, and assumptions regarding implementation rates, location of the solar industry in Canada, and the reliance on imports, are also examined. Results show that direct employment from now to 2000 could amount to 170,000 man-years, and indirect employment could be 3 times this figure. The resultant employment would be distributed according to the rate of solar heating implementation in each region. The rate of increase in employment exceeds the rate of increase in energy savings. Variations in the rate of implementation mean more for employment than variations in the extent to which Canada relies on imported collectors. 35 refs, 1 fig., 75 tabs.

14933 **(NRC—8208) Minutes of the Renewables Task Coordinating Committee.** (National Research Council of Canada, Ottawa, Ontario). 1982. 108p. (CE—02290). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A meeting of the coordinating committee for Canadian renewable energy projects was held to discuss program strategies and budgets, and to report on overall progress in the various parts of the program. This document outlines what was discussed at the meeting and presents descriptions of the programs and sub-programs concerned, which cover the fields of solar energy (active and passive domestic and commercial systems, photovoltaics), bioenergy (including resource assessment, forestry biomass production, biomass conversion technologies), wind energy, geothermal exploration and resource assessment, energy from peat, and hydraulic energy. 41 tabs.

14934 **(SPC—C-8(2)) The social, environmental and resource impact of wood gasification on isolated northern communities. Part 2.** (Saskatchewan Power Corp., Regina (Canada)). 1980. 45p. (CE—02131). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report is concerned with the potential environmental consequences of the operation of wood gasification plants, and is based on the emission data collected during a trial operation of a pilot plant at Hudson Bay, Saskatchewan. The plant was monitored to determine the composition of the raw fuel, composition of the raw gases and emissions, noise levels, and composition of wastewater. For comparison, a general description was made of environmental qualities already existing in Pinehouse, a typical remote northern Saskatchewan community without a gasification plant and using diesel generators as a local electric power source. It was found that particulates, carbon dioxide, nitrogen, and nitrogen oxides are produced at the gasification plant in small enough amounts that local winds will disperse and dilute the emissions. The additional noise generated by the plant is not significant. Liquid wastes in the form of tars and wastewater are produced; the wastewater, containing phenols, will have to be treated and disposed in an appropriate manner. This is necessary, notably if disposal into or near a water system is contemplated, since phenolic derivatives are harmful to aquatic organisms even at low concentrations. Some possible treatment methods include oxidation, use of aquatic plants, and biological treatment. Overall, the impact of such a plant on a community like Pinehouse is seen to be positive, in light of the plant's relatively small environmental impact and its high social benefits if used as a power source for electricity generation. 31 refs., 3 figs., 15 tabs.

14935 **(VB—ER80-10E) Renewable energy in remote locations: energy demand and resource base.** (Victor and Burrell (Canada)). [1989]. Vp. (MICROLOG—82-3708; CE—02244). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Analysis is made of energy demand characteristics in Canadian remote areas to the year 2000, in order to assess the market potential and feasibility of renewable energy sources to supply that demand, in competition with conventional sources. In 1980 the total remote population was 141,700, the largest segments being British Columbia and the Northwest Territories. This population is expected to decline as some communities become connected to grids and thus are no longer considered as remote. Total energy use in 1980 by remote communities in Canada is estimated at 8.3 PJ, expected to fall to 6.6 PJ by 2000. Over 60% of the energy demand is for residential use, mostly space heating. About 60% of end-use energy was supplied by heating oil, 25% by diesel, and 15% by wood. Major remote communities have ca 350 MW of diesel electric generating capacity installed, requiring ca 1.3 million bbl/y of diesel oil supplied at high cost. Examination of the availability of alternative, renewable energy sources in remote areas is surveyed for solar, wind, ocean-related, biomass, small hydro, geothermal, and peat sources. A preliminary review suggests that geothermal and ocean-related sources offer little possibility of contributing to the energy supply; peat has possibilities in certain areas; active solar may have a limited but strategic role, the main problem being the large seasonal variations; small hydro and wind sources look promising at a number of sites; and biomass, especially from the forest, is available, already in use, and has a significant additional potential as a source for electricity generation in a number of areas. 10 figs., 46 tabs.

14936 **Energy technologies for the developing countries.** Srinivasan, S. (Los Alamos National Lab., Mechanical and Electronic Engineering Div. MSD429, Los Alamos, NM (US));. pp v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. Pennington, NJ; The Electrochemical Society (1987). (CONF-870560—).

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

The energy scenario in the developed countries is quite different from that in the developing countries. Firstly, the per capita

income in the developing countries is much lower (by a factor which is as high as 50). This is reflected in the variation in energy consumption per capita which could be as low as 0.1 kWy/y in a developing country and as high as 8 kWy/y in the USA. The second problem is that the cost of energy is about two to three times as high in a developing country as compared with that in the U.S.A. There are two basic scenarios in several developing countries in respect to development of energy technologies. One is that there is a rural population (it is as high as 60-70% in countries like India and Pakistan) which requires energy for the basic needs--cooking, lighting and irrigation of agricultural fields. The other is that there is an urban population which seeks a better life style and hence, an increasing demand on energy. A number of these countries had not made serious explorations for fossil fields - natural gas and petroleum in particular - prior to the energy crisis. Within the last five years, new discoveries have been constantly made which changes the scenario and accounts for significant decreases in the import of fossil fuels. The discovery of these resources also creates the need for huge capital investments in the utilization of such energy sources for electricity generation and petroleum refinement.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 14901

14937 (DOE/ID/12735—T1) Component development and integration facility: Quarterly progress report, 1 October--31 December 1988. (MSE, Inc., Butte, MT (USA)). 1988. Contract AC07-88ID12735. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006618/JAW.

This progress report presents the tasks accomplished at the Component Development and Integration Facility during the first quarter of FY89. Areas of technical progress this quarter included: coal system development; seed system development; test bay modification; channel power dissipation and distribution system development; split coal feed system; coal-fired precombustor; iron core magnet thermal protection system checkout; combustion carbon balance and stack gas analysis; coal-fired combustor support; 1A channel refurbishment; arc observation project; dry materials transfer system controls upgrade; test operations and results; data enhancement; technical papers; and projected activities.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 14548, 14846, 14948

14938 (DOE/MC/25117—2636) Thin section porous graphite materials for fuel cell electrode applications: Final report. Tucker, K.W.; Shaner, J.R.; Joo', L.A. (Great Lakes Research, Elizabethton, TN (USA)). Aug 1987. Contract AC21-84MC25117. 70p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000912/JAW.

A proprietary process for the fabrication of thin section porous graphite components invented at Great Lakes Research Corporation (GLRC), continued under development in this program. The principal effort under this program was to solve the technical problems of consistently producing thin sections of porous graphite materials that are uniform in thickness, flatness, mean pore size and pore size distribution, and to provide processes that lower the cost of producing these materials. Materials developed in this program were targeted at applications for electrodes and/or catalyst support backing paper in phosphoric acid fuel cell systems currently under development in the USA. The results of the GLRC program were positive. Principal accomplishments include an improved definition of the range of thin section graphite characteristics that can be produced by the GLRC process, and the effect of key process changes. Also accomplished was development of an optimized process in terms of conformance to major fuel cell developers to NASA Lewis of more than 100 porous graphite sheets in sizes of approximately 33 {times} 46 {times} 0.04 (thick) or 33 {times} 46 {times} 0.22 (thick) centimeters that meet the Lewis Major Systems Contractor fuel cell requirements, and development of wet edge seals for a major fuel cell electrode type. In conjunction with tasks used to demonstrate the versatility and technical and economic feasibility of a batch process, preliminary development of engineering data began the decision of a commercial process. This included preliminary work toward a conceptual design for a continuous process to bake.

14939 (DOE/PC/79931—T3) Oxygen electrode in molten carbonate fuel cells: Fifth quarterly technical progress report, August 1--October 31, 1988. Dave, B.; Adanuvor, P.K.; White, R.E.; Enayetullah, M.A.; Srinivasan, S.; Appleby, A.J. (Texas A and M Univ., College Station (USA)). 1988. Contract FG22-87PC79931. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005813/JAW.

Electrode kinetics of oxygen reduction on gold in molten lithium carbonate was investigated. Steady state cyclic voltammograms were obtained for the peroxide reduction at the gold electrode in Li_2CO_3 melt, results were found to be in good agreement with the data in the literature. Impedance measurements were made as a function of frequency to evaluate the kinetics and mass transfer related parameters. Impedance data were analyzed using a Complex Nonlinear Least Square (CNLS) parameter estimation program and a graphical procedure based upon the Randles-Ershler equivalent circuit. Parameters estimated by both the methods are in good agreement. One of the proposed micro electrodes is a micro ring, which involves a thin gold film positioned tightly between two alumina roots. As an initial study, the stability of gold films, sputter-deposited on alumina substrates, in the Li_2CO_3 melt was determined. 5 refs., 10 figs., 1 tab.

14940 (ECN—88-171) The development of porous components for molten carbonate fuel cells at the Netherlands Energy Research Foundation ECN. Boersma, R.J.; Van der Molen, S.B.; Den Uil, H.; De Vries, J.E. (Netherlands Energy Research Foundation, Petten). Nov 1988. 9p. Stichting Energieonderzoek Centrum Nederland, P.O. Box 1, 1755 ZG Petten, Netherlands.

Some major results are presented of the ECN development activities on the fabrication of porous components for MCFC's in the past two years. Emphasis is given to the fabrication techniques used and the performance of the components in test cells. The importance of optimum pore filling is demonstrated with a 3 cm/sup 2/ cell test in which the carbonate inventory has been changed stepwise. Also, the effect of gas utilization and gas crossover on the performance of a 100 cm/sup 2/ cell is shown. 4 figs., 1 ref., 1 tab.

14941 (ESC-WR—88-27) Status and prospects of fuel cell technology in the Netherlands. Contribution to the WEC study on technical and economic prospects of fuel cells. De Boer, A.A.; Boswinkel, H.H. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Nov 1988. 25p. Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In 1987 the Japanese National Committee of the World Energy Conference decided to start a study on the technical and economic prospects of fuel cells. Their intention is that the final study be compiled on the basis of a series of national studies carried out in the respective countries. This document represents the Dutch contribution to the realisation of this Japanese initiative. It has been executed by the Netherlands Energy Research Foundation ECN in close co-operation with representatives from other research laboratories and industrial enterprises including the utilities and governmental experts in the field of energy. An indication is given of the current approach to the development of fuel cells, of the potential markets up to 2010 and of ways to implement the benefits of fuel cells into the Dutch energy system. 2 app.

14942 **(LA—11483-MS) Carbon monoxide removal by preferential oxidation from hydrogen-rich gas streams.** Vlastnik, V.J.; Armellini, F.J.; Jordano, F.A. (Los Alamos National Lab., NM (USA); Massachusetts Inst. of Tech., Los Alamos, NM (USA). School of Chemical Engineering Practice-Los Alamos Station). Aug 1987. Contract W-7405-ENG-36. 57p. (MIT-LANL—1). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006380/JAW.

The use of methanol as an indirect transportation fuel is currently being investigated at the Los Alamos National Laboratory. In the Los Alamos research, methanol is converted to hydrogen by catalytic steam reforming and water-gas shift reaction processes, The product hydrogen gas stream is then oxidized in a fuel cell operating at temperatures less than 200{degree}C to produce electrical power to drive a vehicle. Residual carbon monoxide contained in the hydrogen stream is a severe poison to the fuel cell electrode. In this study we examined the feasibility of removing the CO to levels of less than 0.1 mol%, while minimizing the consumption of hydrogen. This was to be accomplished by selective oxidation of the CO using a 0.5% platinum-on-alumina catalyst. Experimental results showed that approximately 90% of the CO and only 3% of the H_2 would be oxidized with an O_2/CO ratio of 1, in total gas flows up to 1455 cm^3/min [at 177{degree}C and 158.6 kPa (23 psia)], from a mixture that was initially 2% CO in H_2. When the O_2/CO ratio was increased to 1.5, CO conversion was at or near 100%, and H_2 conversion rose to about 4%. In runs with excess CO_2 present, as would exist in an actual fuel cell, no significant effect on CO oxidation was noted. 122 refs., 16 figs., 5 tabs.

14943 **Electrode kinetics of fuel cell reactions at the platinum/solid polymer electrolyte interface.** Srinivasan, S.; Paik, W.K.; Ticianelli, E.A.; Springer, T.E. (Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

EIECTRODE KINETIC STUDY - RELEVANCE TO SPE FUEL CELL. The solid polymer electrolyte (SPE) fuel cell system shows great promise of attaining high power densities, and the authors have recently demonstrated this with low platinum loading (0.35 mg/cm/sup 2/) electrodes. This is achieved by the impregnation of a perfluorinated sulfonic acid polymer (Nafion) into the electrode structure to extend the three-dimensional reaction zone. Extensive studies have been carried out on a number of aqueous perflourinated sulfonic acids, particularly CF/sub 3/SO/sub 3/H, with respect to oxygen reduction kinetics with platinum as the test electrode. However, there have been few such studies at the interface of platinum with the perflourinated sulfonic acid polymer membranes. The present study investigates the electrode kinetics of fuel cell reactions (hydrogen oxidation and oxygen reduction) at the platinum/solid polymer electrolyte interface in an attempt to understand the factors controlling the performance of the ionomer-impregnated porous electrodes and to ascertain the extent of platinum utilization in the electrodes.

14944 **The transfer coefficient for O/sub 2/ electroreduction.** Yeager, E.; Clouser, S.J.; Huang, J.C. (Case Center for Electrochemical Sciences, and the Chemistry Dept., Case Western Reserve Univ., Cleveland, OH (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

For platinum, rotating ring-disk electrode (RRDE) measurements provide evidence that O/sub 2/ reduction proceeds principally through the 4-electron pathway in both acid and alkaline aqueous electrolytes in the absence of adsorbed impurities. A typical Tafel-type plot obtained on a rotating disk electrode with correction for O/sub 2/ mass transport is shown for concentrated phosphoric acid. [I/sub d/ corresponds to the diffusion limiting current and I to the observed current.] This electrolyte is of special interest because of its use in advanced fuel cell power plants. At potentials more negative than 0.80 V vs. a reversible H/sub 2/(atm) electrode in the same electrolyte (RHE), the Tafel slope approaches a value of -0.12 V (decade)/sup -1/, while at more positive potentials the slope shifts to a lower value. At these more positive potentials, the voltammetry curves in this electrolyte indicate the presence of an anodic film, probably consisting of adsorbed OH, inhibiting O/sub 2/ reduction. The potential dependence of the anodic film coverage, coupled with the intrinsic potential dependence of the energy barrier for the charge transfer step in the O/sub 2/ reduction reaction apparently results in the lower Tafel slope. At more negative potentials, the anodic film is no longer involved to any significant extent and the Tafel slope -0.120 V (decade)/sup -1/ corresponds to an apparent transfer coefficient of 1/2 at 25°C.

14945 **Electrocatalysis of fuel cell reactions at platinum/proton-exchange membrane interface.** Paik, W.K.; Ticianelli, E.A.; Srinivasan, S. (Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

To study the electrocatalytic activity at the platinum/perfluorosulfonic acid ionomer interface for fuel cell reactions of oxygen and hydrogen, a cell was designed and fabricated in which platinum gauze working and counter electrodes could be pressed on both sides of the ionomer membrane. The hydrogen and oxygen adsorption/desorption characteristics and the electrode kinetics of the fuel cell reactions were then examined using ionomer-coated and uncoated platinum gauze test electrodes. Although the results with the uncoated gauze indicated that the portion of platinum wire surface not in direct contact with the membrane contributes to the hydrogen and oxygen adsorption/desorption, thin films of the proton exchange polymer on the mesh increased the current densities for the fuel cell reactions up to several times over the uncoated gauze electrode. This increase in the current density far exceeded the increased expected on the basis of increase of surface area, as determined by the hydrogen adsorption charge from the cyclic voltammetry. Currents at high overpotentials showed both diffusion limitation and resistance effects of the electrolyte coatings. The results obtained in these studies could be used for determining (1) effects of potentially useful proton exchange membranes on the electrocatalytic activity of fuel cell reactions, and (2) the effective utilization of platinum in porous gas diffusion electrodes with supported electrocatalysts.

14946 **High-resolution computed tomography for flaw detection in advanced thin-layer ceramics for fuel cells.** Sawicka, B.D.; Ellingson, W.A.; McPheeters, C. (Chalk River Nuclear Labs., Ontario Canada (CA));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Advanced monolithic solid oxide fuel cells are being assembled from thin tape-cast ceramic layers with tailored mechanical properties. The layers need to be free of cracks and nonbonds. A high-resolution computed tomography system with a /sup 192/Ir source was investigated as a tool for detecting cracks and nonbonds. Results suggest that channel sizes, including internal channels, can be determined but small in-plane cracks cannot be detected.

14947 **Modeling thin-gap channel flow cells.** Edwards, V.; Newman, J. New York, NY; American Institute of Chemical Engineers (1987). 38p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 70B.

A technique is presented for solving the equations describing the current, concentration, and potential distributions in an undivided laminar-flow-channel electrochemical reactor. The equations account for multiple electrochemical reactions, interacting boundary

layers, and both axial and normal variations of current, concentration, and potential. Migration as a specific flux component is not taken into account, but ohmic potential drop is. The governing equations are solved using orthogonal collocation extended with an additional set of functions that match the singular behavior near the electrode edges. Thus the method is more accurate than conventional orthogonal collocation, especially for primary and limiting current distributions. Potential distributions calculated by this method show that even for a small aspect ratio (h/L=0.1), the axial variation of potential must be included in the equations.

3008 Miscellaneous Converters

14948 (LA—11484-MS) Heat and mass transport in fuel cell electrodes. Sung, S.; Krueger, C. (Massachusetts Inst. of Tech., Los Alamos, NM (USA). School of Chemical Engineering Practice-Los Alamos Station). Jan 1989. Contract W-7405-ENG-36. 59p. (MIT-LANL—2). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006378/JAW.

The operation of a hydrogen/oxygen fuel cell is dependent on the rate at which product water can be removed from the cathode. The carbon-Teflon paper boundary between the cathode and air supply has been studied regarding the transport phenomena occurring within it. Heat and water removal and the transport of oxygen to the cathode have been considered. Experiments run on a simulated fuel cell revealed that gravity is important in water drainage through a carbon-Teflon felt. Preliminary experiments conducted have indicated several modifications to the existing apparatus. A theoretical model has been developed in which the carbon-Teflon paper is treated as a porous continuum. Transport rates and temperature and pressure profiles can be estimated by numerically solving the equations governing heat, mass, and momentum transfer. Experimental results will be used to verify the model. 10 refs., 16 figs., 2 tabs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 14905

3201 Buildings

REFER ALSO TO CITATION(S) 14548, 14579, 14833, 14834, 14836, 14849, 14870, 15025, 15029, 15041, 15051, 15056, 15060, 15068, 15072, 15074, 15420, 15941, 15942

14949 (AC/R—1981) Energy conservation in greenhouses. Jackson, H.A. (Agriculture Canada, Ottawa, Ontario. Research Branch). 1981. 28p. (CE—02260). Agriculture Canada, Ottawa, Ontario, Research Branch.

A number of techniques are outlined in this report on reducing heat losses, increasing heating system efficiency, and achieving fuel economy in greenhouse operations in Canada. Factors that have a significant effect on heat losses are discussed, including climate and type of covering material, which can be remedied by proper insulation and sealing methods. A system using double polyethylene layers inflated by outside air in conjunction with glass is presented which has potential energy savings of 40-60%. Retractable insulation systems are also suggested as an effective means for reducing heat losses. Other procedures mentioned include using external windbreaks, lowering night temperatures, using exhaust air heat exchangers, and using soil warming systems. In optimizing the efficiency of the greenhouse heating system, proper maintenance is essential. Modifications to improve the heat transfer in firetube boilers are described, and the use of gas-fired low intensity infrared heaters is proposed as a way to reduce fuel costs. Another way to reduce fuel costs is to use alternate fuels/heat sources, such as solar energy, waste industrial heat, and wood. 7 refs., 4 figs., 3 tabs.

14950 (AMU—8803) Spray applied cellulose insulation for walls. Manning, K. (Alberta Municipal Affairs, Edmonton (Canada)). 1988. 77p. (MICROLOG—88-05143). Alberta Municipal Affairs, Jarvis Bldg., 6th Floor, 9925-107 St., Edmonton, Alta., Canada T5K 2H9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Cellulose insulation has traditionally been used as an attic loose-fill where its void free, blanket coverage has been recognized as an effective means of reducing heat loss through air leakage. The objective of this study was to develop a method for extending use of this material to exterior wall systems where air leakage is known to be a difficult problem to control using conventional methods. Work undertaken involved developing a spray nozzle and application technique which enabled spraying a moist mixture of insulation and adhesive into open stud cavities so as to form in place a free standing, full fitting blanket of insulation. Further laboratory work was done to establish actual moisture content of the installed material and the rate at which the moisture would dissipate from an enclosed wall cavity. Several field installations were undertaken successfully. One installation is currently being monitored for air leakage and moisture dissipation. It has been determined that the installation procedure is practical, that air leakage is substantially reduced, and that builders aiming at R2000 criteria can use this system cost effectively. 4 figs.

14951 (CHRI—8245-1) Energy conservation as a result of heat recovery in a balanced ventilation system. Project Middenhoven in Amstelveen. Measuring period winter 1985-1986. Cauberg, J.J.; Steps, M.P. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jul 1988. 50p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756165/JAW.

Within the framework of the first program section Prego/plus 'Balanced ventilation with heat recovery', measurements were carried out concerning characteristics of the ventilation system, in particular the efficiency of the annual energy conservation as a result of the heat recovery unit. The project Middenhoven in Amstelveen concerns skeleton woodwork houses with a convector heating in combination with a balanced ventilation system with heat recovery. Appendix 1 gives the measuring method, equipment and results of airtightness measurements that were carried out in one of the houses. 10 figs., 6 tabs., 2 app.

14952 (CHRI—9029) Energy conservation as a result of heat recovery in a balanced ventilation system. Project Born, Netherlands. Measuring period winter 1986-1987. Cauberg, J.J.; Steps, M.P. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jul 1988. 51p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756166/JAW.

Within the framework of the first program section Prego/plus 'Balanced ventilation with heat recovery' measurements were carried out concerning the characteristics of the ventilation system: in particular with regard to the efficiency of and the annual energy conservation as a result of the heat recovery from the ventilation air. The project concerns 16 free-sector houses with an indirectly heated 2-zone air heating unit in combination with a balanced ventilation system with heat recovery. As a reference 25 houses of the project have been provided with radiator heating systems in two insulation classes. Appendix 1 gives the measuring method, equipment and results of the investigation on the airtightness of one of the houses in the project. 10 figs., 8 tabs., 1 app.

14953 (CHRI—9031-1) Energy conservation as a result of heat recovery in a balanced ventilation system. Project Heyerveld in Maasbree, Netherlands. Measuring period winter 1986-87. Cauberg, J.J.; Steps, M.P. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Aug 1988. 62p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756167/JAW.

Within the framework of the first program section PregoPlus 'Balanced ventilation with heat recovery' measurements were carried out concerning the balanced ventilation systems: in particular the efficiency of the annual energy conservation as a result of the

heat recovery unit. The project Heyerveld in Maasbree consists of 30 dwellings of which 15 have a radiator heating in combination with a balanced ventilation system with heat recovery. As a reference 15 houses were provided with a mechanical extractor system. Appendix 2 gives the measuring method, equipment and results of the investigation of the airtightness of one house of the project. 12 figs., 8 tabs., 2 app.

14954 **(CHRI—9741-1) Experiment heating costs contract. Calculation and testing of Reasonable Energy Consumption.** Op 't Veld, P.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jun 1988. 37p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756168/JAW.

For a number of residential buildings in the Netherlands contracts between tenants and renters have been negotiated in which it is agreed what the so-called Reasonable Energy Consumption standard is for the houses concerned. A method was developed for residential buildings to determine such a standard. The calculation method and the starting points are discussed as well as the way in which the calculated energy consumption can be tested to the recorded consumption. During the heating season 1987-1988 experience has been gained with a heating cost contract and testing of the Reasonable Energy Consumption standard in four projects. The results of the experiments in these four projects were laid down separately in reports for which abstracts have been prepared. 5 tabs., 1 app.

14955 **(CHRI—9741-2) Experiment heating costs contract. Testing site Tilburg, Netherlands.** Op 't Veld, P.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jun 1988. 41p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756169/JAW.

Report 9741-1 of Cauberg-Huygen Engineering Consultancy accounts for the way in which the so-called Reasonable Energy Consumption is calculated and tested. This standard is a basis for the heating cost contract. Four sites in the Netherlands have been selected to gain experience with the contract and the notion Reasonable Energy Consumption during a heating season. Attention was paid to the effects of the contract and the calculation and testing of the energy consumption as well as to the consumer behavior with regard to energy conservation. This report discusses the project in Tilburg where a complex of two apartment buildings has been selected. The experiment was supported by an extended measurement program and a resident inquiry. 11 figs., 14 tabs., 1 app.

14956 **(CHRI—9741-3) Experiment heating costs contract. Testing site Renkum, Netherlands.** Op 't Veld, P.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jun 1988. 14p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756170/JAW.

Report 9741-1 of Cauberg-Huygen Engineering Consultancy accounts for the way in which the so-called Reasonable Energy Consumption is calculated and tested. This standard is a basis for the heating cost contract. Four sites in the Netherlands have been selected to gain experience with the contract and the notion Reasonable Energy Consumption during a heating season. Attention was paid to the effects of the contract and the calculation and testing of the energy consumption as well as to the consumer behavior with regard to energy conservation. This report discusses the project in Renkum where an apartment building was selected in spite of the fact that the installation in the building is an old one, has no pre-control and non-insulated pipes and fittings. 3 figs., 5 tabs.

14957 **(CHRI—9741-4) Experiment heating costs contract. Testing site Vianen, Netherlands.** Op 't Veld, P.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jun 1988. 25p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756171/JAW.

Report 9741-1 of Cauberg-Huygen Engineering Consultancy accounts for the way in which the so-called Reasonable Energy Consumption is calculated and tested. This standard is a basis for the heating cost contract. Four sites in the Netherlands have been selected to gain experience with the contract and the notion Reasonable Energy Consumption during a heating season. Attention was paid to the effects of the contract and the calculation and testing of the energy consumption as well as to the consumer behavior with regard to energy conservation. This report discusses the project in Vianen where a complex of HAT-units (small dwellings for one or two persons) was selected. The experiment was supported by a measurement program. 9 figs., 8 tabs.

14958 **(CHRI—9741-5) Experiment heating costs contract. Testing site Eindhoven, Netherlands.** Op 't Veld, P.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Jun 1988. 12p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756172/JAW.

Report 9741-1 of Cauberg-Huygen Engineering Consultancy accounts for the way in which the so-called Reasonable Energy Consumption is calculated and tested. This standard is a basis for the heating cost contract. Four sites in the Netherlands have been selected to gain experience with the contract and the notion Reasonable Energy Consumption during a heating season. Attention was paid to the effects of the contract and the calculation and testing of the energy consumption as well as to the consumer behavior with regard to energy conservation. This report discusses the project in Eindhoven where an apartment building has been selected in spite of some imperfections of the heating system. 3 figs., 5 tabs.

14959 **(CHRI—9795-2) Eleven dwellings of plan Diepenbroek in Baarlo, Netherlands. Measurements with regard to air-permeability of the dwelling and the functioning of the air heating equipment.** Op 't Veld, P.J.; Cauberg, J.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). May 1988. 45p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756173/JAW.

The measurements as stated in the title are part of the program section 'Element construction' of the PREGO/PLUS-program 'Integral Design and Construction'. The aim of this program is to demonstrate energy saving building possibilities with large cellular concrete element. Special attention is paid to the integration of all the energy aspects during the building process. In these well insulated and airtight dwellings an installation for space heating and ventilation has been applicated which system has been geared for this building process. The system consists of a two-zone air heating with balanced ventilation and heat recovery, and a selective recirculation. 19 figs., 6 tabs.

14960 **(CHRI—9939-1) Tracing of leakages in heat recovery equipment by means of a tracer gas, and the influence of leakages on the efficiency.** Cauberg, J.J.; Van Gerwen, R.J. (Cauberg-Huygen Raadgevende Ingenieurs B.V., Maastricht (Netherlands)). Mar 1988. 46p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756174/JAW.

Air leakages in heat recovery equipment used in dwellings are discussed as well as the undesired consequences. A theoretical model was constructed to determine leaks in a heat recovery unit 'in-situ' without measuring inside the unit. Next a model has been designed to be able to determine an adjusted efficiency from the leak flows. This model is translated into a practical procedure to test a heat recovery unit. The heat recovery unit has a so-called cross-flow heat exchanger. The use of such a heat exchanger, however, is not essential with regard to the calculation or the measuring method. Therefore the final results are also valid for other heat exchanger types. 14 figs., 11 refs., 2 tabs.

14961 **(CSTB-R—66-87-L) Application of optimal control methods to energy systems in buildings.** Rubinstein, M. (Centre Scientifique et Technique du Batiment, 75 - Paris (France)). Oct 1987. 138p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756638/JAW.

The studies performed by CSTB and here after reported are: Modeling and simulation of an energy station used in office build-

ing. This piece of work comes within the scope of the Ircose research group working plan, which aims to apply optimal control to energy system in buildings. For the preliminary analysis, it has been necessary to adapt simulation codes, so as to represent the dynamic behaviour of multi-sources energy station and a heat distribution network; a survey about identification methods applied to thermal analysis in building; a study about direct gains control in passive buildings. This takes place in the general framework of the European concerted action on control of passive solar system which aims to develop different types of controllers for passive solar buildings. Three proposals are involved in this project and the participants are: The technical University of Delft (Nederland), Armines (France), Napac (France), CSTB (France). This project started on september 1986 and two periodic meetings have yet been held in DELFT and PARIS. Today, the concertation has led to the choice of a reference passive solar system for the final comparison of the different controllers.

14962 **(DOE/CE/64869—T1-App.B) Development of community-sponsored financing programs for hospital energy investments.** (Michigan Hospital Association Service Corp., Lansing (USA)). Dec 1988. Contract FG01-86CE64869. 55p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006835/JAW.

This initiative was to be carried out in three phases: establishment of a community data base by conducting energy audits in four to five financially distressed institutions within each of the two demonstration site communities; development of a community-sponsored financing program based upon an assessment of community resources, level of institutional investments, and alternative sources of capital available; and implementation and evaluation of community sponsored financing programs through monitoring investments and documenting the program development process. On March 4, 1987, the MHASC was given a grant to assist in the first two phases of the initiative. In Phase I, the MHASC assisted HHS in the identification of the sites. In Phase II, the MHASC was charged with the development of a community sponsored financing program to meet the needs of the Michigan hospital community. The results of the MHASC findings are contained in this report. 5 figs.

14963 **(DOE/SF/16306—5) Design and testing a solar cooling system employing liquid desiccants: Dehumidifier experiments in Colorado State University Solar House II: Final report, 1986--1987.** Lenz, T.G.; Loef, G.O.G.; Patnaik, S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Dec 1987. Contract FG03-86SF16306. 53p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006865/JAW.

A nominal 3-ton (10.5-kW) lithium bromide, open-cycle desiccant cooling system has been designed, installed, and operated. This experimental system dehumidifies ambient air in a packed bed utilizing an aqueous solution of lithium bromide. The absorbent solution is distributed by spray nozzles and flows countercurrent to the air. The dilute solution exiting the dehumidifier is concentrated in a packed bed regenerator by solar heated air. The strong solution is cooled by two heat exchangers before reentering the dehumidifier. Provisions to simulate conditions of high ambient humidity and temperature have been made. Experiments on the dehumidifier operating in a decoupled mode (without countercurrent regenerator operation) have been carried out. Cooling capacities in the range of 1.0–4.0 refrigeration tons have been achieved, depending upon the operating conditions. The effect of different independent variables on the capacity of the dehumidifier has been studied. An empirical equation correlating the variables have been obtained by statistical analysis of the data. The equation obtained indicates that the capacity of the dehumidifier depends strongly on the solution concentration, solution flow rate, air inlet temperature and the air humidity. Two other variables studied, the solution inlet temperature and the air flow rate, did not affect the cooling capacity greatly. The dependence of condensation rate on each of the variables is analyzed. 22 refs., 17 figs., 3 tabs.

14964 **(DOE/SF/17289—T1) Weatherization installation standards.** (Heath (Richard) and Associates, Fresno, CA (USA)). [1989]. Contract AC03-88SF17289. 213p. NTIS, PC A10/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006501/JAW.

This document is intended to serve as a voluntary installation and inspection guide for state and local agencies participating in the US Department of Energy's Weatherization Assistance Program. This installation and inspection guide addresses several of these shortcomings by providing uniform, objective, clearly written and illustrated standards for the installation of measures. The standards serves as benchmarks for defining quality workmanship and as tools for measuring quality performance. As such, this user-friendly guide can serve as a valuable resource to state and local agencies when defining critical-fail performance elements, when training workers, or when inspecting completed dwelling units.

14965 (EMR—9008, pp 23) **International residential energy and use data: analysis of historical and present day structure and dynamics.** Schipper, L.; Ketoff, A. (Lawrence Berkley Lab., CA, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper describes ongoing efforts to disaggregate data on residential space comfort and appliance energy use for major OECD countries, in order to facilitate international comparisons of residential energy use. Indicators of structure (i.e. dwelling size, number of appliances, incomes) and of energy intensity are developed for various countries and compared. Data on residential energy use are given on several bases: space heating per capita, per household, and per m/sup 2/; water heating and cooking per dwelling; and appliance energy per capita, per household and per unit of real income. The factors that influence the development of energy use are discussed; it appears that structural changes, related to increases in income or in activity levels, may account for much of the increase in space heating use in most countries of Europe. Preliminary assessment of available data also suggests that growth in non-heating energy use is largely related to incomes. Examination of energy intensities indicates a slowing of growth previously evident in periods when, for example, the appliance market was not as saturated. Considerably less growth in energy use relative to incomes is expected in the future. Comparison across incomes suggests that electricity prices in particular are extremely important determinants of consumption. There are still significant areas of possible improvements in residential energy conservation. The data showing a large variation in energy use per capita for a given end use, a variation too large to be explained only by technology, indicate that behavior plays a key role in energy use and conservation. 12 refs., 1 fig., 5 tabs.

14966 **(EMR/ERL—78-82F) Wood stoves: efficient design and performance.** Hayden, A.C.S. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Energy Research Labs.). 1978. 52p. (In French). (CE—02263). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report discusses the appliance efficiency of wood burning stoves, how to measure it, and the effectiveness of various stove designs. Separate abstracts have been prepared for two papers from this report.

14967 (EMR/ERL—ERP/ERL78-82F, pp 30) **Efficiency of wood-fired appliances.** Hayden, A.C.S. 1978. (In French). Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. (CE—02263).

In Wood stoves: efficient design and performance.

This paper discusses the four techniques used to measure the efficiency of wood-fired appliances; that is, the ratio of the heat supplied to the house to the heat in the wood. The most accurate, reproducible method is the Instantaneous Heat Loss Method. Comparison with known systems in-situ gives a useful measure of the

real efficiency of wood stoves in heating homes. To properly complement existing heating systems, the stove should be placed in a major living area. If this is done, efficient air-tight wood stoves can be an effective energy conservation device in home heating. 4 refs., 7 figs., 7 tabs.

14968 (EMR/ERL—ERP/ERL78-82F, pp 19) **Effect of wood stove design on performance.** Hayden, A.C.S.; Braaten, R.W. 1978. (In French). Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. (CE—02263).

In Wood stoves: efficient design and performance.

Using an indirect stack loss method to measure efficiency and performance characteristics, a series of experiments was carried out on wood-fired space heaters (stoves). A good stove design should allow the heater to run a majority of the time at a reasonably low-excess air level and flue gas temperature without producing excessive emissions of incomplete combustion products. Results on five different stove types show that a fireplace or non-airtight stove is very inefficient and can have high emissions, while a well-designed and well-constructed airtight stove may have efficiencies as high as 77%. In particular, sidedraft designs and, to a lesser extent, horizontal baffle designs appear to offer potential for higher efficiencies and lower emissions than other stove types. 3 refs., 7 figs., 1 tab.

14969 **(INA—1977) Construction in permafrost; obstacles of soil and climate.** (Department of Indian and Northern Affairs, Ottawa, Ontario (Canada)). 1977. 16p. (In English and French). (CE—02335). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document gives a basic introduction to the properties of permafrost in northern Canada, as they affect the construction of buildings, roads and other structures. The southern limit of permafrost is not well defined, and in practice it is a belt of land in which areas of continuous permafrost alternate with areas of sporadic permafrost. The latter areas provide special difficulties to the engineer, as the existence of permafrost is hard to predict and such permafrost as exists is close to melting and therefore quite instable. Much of northern Canada is underlain by soils containing high ice content, which can become a soft slurry if melted. This requires preservation of the frozen condition if soil strength is to be maintained, and careful attention must be paid to such requirements as protection of the natural insulation of the ground cover, providing for drainage of water that could thaw the permafrost, using special construction techniques, and conducting detailed site studies. Insulating blankets of gravel may be necessary for roads and related structures, and in the case of buildings, ventilation underneath the floor and the use of pile foundations are frequently used. Past experience shows that costly problems can arise if permafrost is ignored, but with proper application of known techniques and careful attention to detail at all stages of work, all types of engineering projects can be carried out in permafrost areas.

14970 **(INA/TSC—EA-HQ-86-41) Report on research development project, energy efficient northern housing, Frobisher Bay, N.W.T.** (Department of Indian and Northern Affairs, Ottawa, Ontario (Canada). Technical Services and Contracts). 1986. 51p. (CE—02273). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Two similar houses were constructed in Frobisher Bay, Northwest Territories in 1978 and 1980, built to high standards of insulation and air tightness suitable for the northern climate. This report presents the observations and conclusions drawn from the comparative analysis of site data on the building envelopes of those two houses, and on the effectiveness of an air-to-air heat exchanger located in one of the houses. Data were obtained on such parameters as energy consumption, air temperature and humidity, ventilation rates, and solar domestic hot water heating. Thermographic, air quality, and air tightness studies were also carried out. Data were analyzed to determine the effectiveness of the energy efficient house designs, construction methods, energy-saving equipment and operational methods. Total energy performance was evaluated by performing an energy analysis and a life-cycle costing/cost-benefit analysis. The impact of energy conservation in relation to northern life styles, health problems and socio-economic aspects was also considered along with occupant satisfaction and needs. Results of the tests showed that the thermal performance of the houses was at the designed levels. The use of the air-to-air heat exchanger was effective in reducing heat loss. The use of solar energy for preheating water was effective and the system has performed well, but the relatively high initial cost has not made it cost-effective. Occupancy life styles and habits are a dominant factor in indoor temperature, humidity, and air quality. 7 refs., 38 figs., 2 tabs.

14971 **(Juel-Spez—384) Analysis of the design, operation and provision of heating systems for households. Heat demand - technical systems - costs - market decision making.** Kollmann, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung; Essen Univ. (Gesamthochschule) (Germany, F.R.)). Dec 1986. 475p. (In German). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek.

Angewandte Systemanalyse.; no. 49.

The central subject of this report is the analysis of space heat supply in the detached and semi-detached houses built during the period of the two oil crises (1972-1984). The aim of the treatise is to determine whether the change to other heating systems can be primarily explained by the changed technical and economical basic conditions during this period. As basic hypothesis it is claimed that the substitution processes observed between the heating systems are the result of a rationally planned decision based on economical calculations. In view of the provision of space heating installations, this means the consideration and use of methods which lead to the technical design, operation analysis or to the compiling of an economic value judgement. The working steps resulting from this refer to 1. the calculation of the heat demand of a building, 2. assessment of the energy consumption of comparable heating systems, 3. choice of method of calculating the efficiency and determining the input values. To analyse the decision for heating systems, a graphical method is developed, with which the connection between cost development and decision of choice is studied. Within the scope of the analysis made, special attention is paid to the substitution of conventional heating systems amongst themselves (oil, gas, and coke boiler as well as district heating and night-storage heaters), the assessment of energy-saving, innovative heating systems (heat pumps).

14972 **(KTM/E-D—158) Energy economic use and maintenance of buildings.** Aho, T.; Sautola, E.; Marttila, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Rakennustalouden Lab.). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jun 1988. 250p. (In Finnish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756270/JAW.

The research treated development of building automation systems, cyclical inspection and service besides building-service organizations. 25 Fmk was used for the building maintenance in 1986 which was about 80% from the construction investments. The most prominent cost factors were energy and work. The conservation of the original quality level demands 0.3-0.8 per cent yearly investments measured from replacement value. An efficient energy use is often prevented by non-technical reasons. The problems are clutched with organizations, administration, contracts, information, motivation, work orientation and quidance besides education and wages. Energy conservations can be achieved without comfort decrease by automation of operation activities, well planned and drafted activities of operation and service inspection. The achieved energy conservations were about 10 per cent. Adaption of new methods and organization reform are in question. The project has applied the idea of measuring maintenance which has been lended from industry and is based on reliability in running and economic viability. The payback period of control and monitoring systems on residential areas was about 6 years with 6 per cent interest. In the areas with miscellaneus real properties the payback periods were 5-8 years. The payback periods of office and business real properties were 2-5 years. The most profitable objects of making automatic were time controls, alarms and measurements.

14973 **(LBL—20542) Determining daylight illuminance in rooms having complex fenestration systems.** Kim, J.J.; Papamichael, K.M.; Selkowitz, S.; Spitzglas, M.; Modest, M. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 9p. (CONF-861109—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006716/JAW.

From 2. international daylighting conference: architecture and natural light; Long Beach, CA, USA (5 Nov 1986).

Traditional computational models predict daylight illuminance in a space by dividing window surfaces into discrete areas and then calculating the apparent luminance of each window element by multiplying the luminance of the natural light source in a given viewing direction by the window transmittance in that direction. This approach works well for conventional glazing materials but is incapable of modeling commonly used, but complex, window systems such as those with specular reflective venetian blinds. We describe a new approach that combines measured luminance distributions for complex window systems with a flux transfer calculation within the space. This method resembles the calculation of illuminance from electric light fixtures where the candlepower distribution of the fixtures is measured and used as an input to the calculation. Based on the variable luminance characteristics of the window system, the SUPERLITE program calculates illuminance at the workplane over the entire space. The measurement techniques and mathematical implementation in the SUPERLITE program are described. This approach allows a wide range of complex and shading systems to be evaluated without continuous changes in the computational program. A special apparatus for measuring the bidirectional transmittance of window systems has been built in conjunction with this approach. Sample results from the program are compared to measurements made in scale models in a sky simulator. 5 refs., 6 figs.

14974 **(LBL—20543) Solar-optical properties of multilayer fenestration systems.** Papamichael, K.; Winkelmann, F. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 7p. (CONF-861109—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006664/JAW.

From 2. international daylighting conference: architecture and natural light; Long Beach, CA, USA (5 Nov 1986).

The bidirectional solar-optical properties of a fenestration system are necessary to accurately determine its luminous and thermal performance. Bidirectional transmittance and reflectance can be determined experimentally for fenestration systems of arbitrary complexity using a scanning radiometer, after which the total directional absorptance can be calculated. However, for the case of multilayer fenestration systems, this approach does not provide information about the net absorptance of each layer. Moreover, the same layers can be ordered in more than one way, resulting in fenestration systems with different solar-optical properties, the determination which requires additional experimental procedures. This paper describes a mathematical model for the calculation of the bidirectional solar-optical properties of multi-layer fenestration systems, using the bidirectional solar-optical properties of each layer. The model is based on the representation of the bidirectional solar-optical properties using matrices. Matrix operations are then used to calculate the bidirectional solar-optical properties of any combination of layers, considering the interreflections between them. This approach offers two advantages: (1) the reduction of the experimental procedures to those required for the determination of the bidirectional transmittance and reflectance of fenestration layers, rather than complete fenestration systems, and (2) the determination of the net absorptance of each layer as part of the fenestration system, rather than the total absorptance of the complete fenestration system. 7 refs., 4 figs., 1 tab.

14975 **(LBL—25487) U-values, solar heat gain, and thermal performance: Recent studies using the MoWiTT.** Klems, J.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098;AI79-86BP64353. 18p. (CONF-890105—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006666/JAW.

From ASHRAE winter symposium; Chicago, IL, USA (28 Jan 1989).

U-value measurements made with the MoWiTT field test facility and at a commercial test laboratory for four commercial windows are compared with calculations made with the WINDOW program. Good agreement is found for three of the windows; for the fourth--a double-glazed window with a highly conductive frame--agreement is good between the calculations and the MoWiTT measurements, but agreement with the test laboratory is only marginal. Measurements of overall diurnal performance are presented, and it is shown that, even for a north-facing window, the uncertainties in thermal performance due to solar gain effects overshadow the effects of improved U-value. The author argues the need for better methods of accounting for solar gain effects in window performance comparisons, so that the net benefits of U-value improvements may be correctly assessed. 9 refs., 2 figs., 9 tabs.

14976 **(LBL—25519-Rev.) Experiments and modeling of the soil-gas transport of volatile organic compounds into a residential basement: Revision.** Garbesi, K. (Lawrence Berkeley Lab., CA (USA)). Dec 1988. Contract AC03-76SF00098. 97p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006833/JAW.

It is assumed that the major pathway for migration of contaminants from landfills was through contamination and movement of groundwater. The migration of methane gas from landfills into nearby residences has indicated the importance of gas-phase transport. Research on the entry of radon gas into houses indicates that the pressure-driven entry of soil gas can result in high indoor concentrations of soil-gas contaminants. This paper presents theoretical and laboratory studies of the advective flow of volatile organics compounds (VOC) through soil, and a field investigation of the pressure-driven entry of VOC into a house adjacent to a municipal landfill. The principals of fluid mechanics are used to derive an analytical model of the pressure-driven flow of VOC in soil. The calculation results in the definition of a retardation factor of VOC with respect to the velocity of the bulk soil gas. The retardation equation is then tested in soil-column experiments using sulfur hexafluoride (SF_6) and hexafluorobenzene (HFB). These experiments are used to evaluate the potential of SF_6 and HFB as tracer gases for use in a field investigation of the advective flow of soil gas into and near the basement of a house near a landfill and to evaluate the potential of the soil-column apparatus for use in screening the advective mobility of VOC important as landfill gas contaminants. The field study consisted of experiments investigating the influence of basement depressurization on the surrounding soil gas, and quantifying VOC contamination at the site. Soil-gas entry into the house during artificial basement depressurization was measured using SF_6 as a tracer, and pressure coupling was measured between the basement and the surrounding soil. Measurements of VOC in ambient air, indoor air, and soil gas indicate that a number of halogenated and oxygenated contaminants present in indoor air had a soil-gas source. 39 refs., 24 figs., 9 tabs.

14977 **(NEI-DK—127) Denmark in Scotland: The energy and housing market 1988.** Joergensen, K. (Praxis Arkitekter og Planlaeggere, Aabyhoej (Denmark)). 1988. 35p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756277/JAW.

A Danish architect and planning firm, "Praxis" (Aarhus), and the Scottish firm "Heatwise" (Glasgow), backed up by the Ministry of Housing, the Scottish Development Agency and the European Communities, have cooperated in order to examine the Scottish market for Danish "know-how" concerning energy conservation and efficiency in relation to the heating of residential buildings. Danish experts could also advise on energy policy and planning and renewable energy sources. The buildings on a large peripheral housing estate were examined in detail, especially with regard to heat losses caused by insufficient insulation and inefficient heating systems. it was discovered that the cost of raising the standard of heating in Scottish residences to that of the average Danish ones would be approximately 7 milliard pounds including necessary general repairs and upheep. There are also many barriers to development inspired by Danish know-how and technology - some being the lack of economical resources and as Glasgow is a town with great poverty problems, other needs hold higher priority amongst

its inhabitants. However cooperation between the Danish and English firms will continue. (AB).

14978 **(NEI-FI—62) Balancing of air-conditioning heating network.** Yrjoelae, J.; Suomalainen, L.; Rahkamo, K. (Projekti-insinoeoerit Oy, (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Nov 1988. 70p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756279/JAW.

The focus of this study was threefold. It examined the operation of LTW (low temperature water) heating networks in several existing air-conditioning systems, the problems encountered with the networks in the various systems and the effect of network balancing on the operation of the air-conditioning systems. LTW network operation was examined for four distinct cases and important modifications, from the point of view of network balancing, were suggested for each case. After these LTW networks were balanced and put back into operations, changes occured in their performance. These differences were examined in each case and an attempt was made to explain them. To assist in the LTW network balancing, a computer program was developed that calculates the necessary balancing valve settings. The results from the program were insufficient in themselves and had to be supplimented by actual on-site fine tuning. On the basis of testing, interviews, theory, etc., the factors that would allow the network to be balanced were determined. These results were then used to outline steps that allow the successful completion of the LTW network balancing. Observations based on test results revealed that there is much room for improvement in air-conditioning system calculations and operation. This study concluded that air-conditioning system LTW networks can be balanced only if each circuit of the network has a balancing valve.

14979 **(NEI-FI—64) Methods to avoid needless use of electric energy in buildings. Preliminary study.** Kaasalainen, M.; Koski, P. (Ekono, Helsinki (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Dec 1987. 91p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756281/JAW.

There are many sometimes even alarming examples of needless use of electric energy in different kinds of buildings. All device groups (lighting, fans etc.) are used needlesly to some degree but it is, however, difficult to estimate reliably the exact volumes. The basis of economical use of electrical devices is the individual design and realization of the building in particular emphasizing operating costs. However this does not guarantee that electrical devices are used economically in future, too. This preliminary study mainly examined methods that might lead to proper use of electric energy in buildings. The most important methods were verified; improvement of understanding of electric energy consumption and sources of expenses; choice of control systems and development of them; education, operating and maintenance rules and advices. More information about the consumption and the distribution of electric energy and the costs would be needed. Consumers should understand what the distribution of their electricity consumption is and what the main sources of the expenses are. That is why, e.g. measurements of electric energy in buildings should be improved. Much attention to the choice of control systems of electrical devices should be paid. Automatic control systems which recognize the needs of use (daylight and occupation sensors etc.) would be useful and profitable in many cases.

14980 **(NEI-FI—67) Technical and economical aspects of using artificial light in greenhouses.** Heinonen, Y.; Nurminen, S. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 69p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756283/JAW.

Various methods of using artificial light in greenhouse production has been examined in the project. Both technical and economical aspects was studied taking in account our climate and marketing conditions in Finland. Also possibilities for using total-energy-unit in the electrical energy supply of the greenhouse was studied. The calculations was made on the basis of exemplary nursery, however, for full scale production mode. It was founded, that plant production under pure artificial light conditions in so called growing rooms is unable to compete with the normal greenhouse production. It is possible to decrease total production costs in normal greenhouse using artificial light to extend the annual growing period. It is advantageous to place multi-layer growing equipments in the greenhouse, because it gives a possibility to increase the capacity of the greenhouse and make the production costs lower. The lowest sum of variable and fixed costs was obtained in the double-layer, rotating growing equipment in whole year use. The total-energy-unit prowed to be competitive, however, the payback-period of the investment will be about 5-6 years.

14981 **(NEI-FI—70) Utilization of building maintenance feedback in Hepac-design.** Sainio, E-O.; Heikkinen, L.; Serimaa, J. (Projekti-Insinoeoerit Oy, Vantaa (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jun 1987. 88p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756286/JAW.

The objective of the study is to improve Hepac-design so, that the information feedback of building maintenance would benefit more the building design. The information has been collected from interviews and literature. The interviewed persons were employers, operation and maintenance personnel, equipment manufacturers, representatives of Hepac-service companies, contractors and Hepac-designers. Feedback collection for use in Hepac-design can be divided into two types, general and individual provision of information. In general collection the information basic data would be available to everyone. In individual collection either a feedback discussion is discussion is arranged with designer or a printed form is given to him. To develop inside conditions and operation of buildings it is necessary to improve information transfer between all persons employed in design and operation.

14982 **(NORDCO—7906) A study of the feasibility of a water-to-air heat pump for the A.H. Murray Building in St. John's, Newfoundland.** (Nordco Ltd., St. John's, Newfoundland (Canada)). 1979. 26p. (CE—02250). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study was conducted to examine the feasibility of installing a water-to-air heat pump for heating a restored historical property in Newfoundland to be used as a commercial building. Water from St. John's Harbour was suggested as the heat source for the heat pump, and a monitoring program was undertaken to measure the water temperature at two depths in the harbor. During the study period, the temperature ranged from -1.5 to 12/sup 0/C, and the fluctuations are influenced by both tidal and wind effects and by the sewage outfalls into the harbor. The performance characteristics of a number of heat pumps were examined, and it was found that the harbor water temperature is too low for commercially available water-to-air heat pumps to operate economically. However, it is suggested that a closed-loop, water-to-air heat pump system is technically feasible and should be investigated further. 13 refs., 7 figs., 1 tab.

14983 **(NRC/BR—131) The Mark XI Energy Research Project design and construction. Building research note no. 131.** Quirouette, R.L. (National Research Council of Canada, Ottawa, Ontario. Div. of Building Research). 1978. 21p. (CE—02245). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Four single detached houses have been constructed near Ottawa, Ontario in order to provide facilities for testing the effectiveness of different measures to reduce energy requirements for single-family houses and to validate computer models used to predict their behavior. This report describes the design and construction of the houses, the special features of each, the monitoring instrumentation, and the role of each house in future research. The first house is of standard construction, the second has upgraded insulation, the third is like the second but also has an air solar heating system with a short-term rock thermal storage unit, and the fourth is like the second but also with an air-to-air heat pump system. The first two houses will be rented to families and will be subject to detailed observations of energy use under actual occupied condi-

tions. The other two houses will be rented for selected experiments and will be used to study the performance of the solar and heat pump heating systems. The houses will be observed over a 2-5 year period, and reporting of data will probably begin after a full weather cycle has been obtained. 6 figs., 1 tab.

14984 **(PB—89-128185/XAB) Thermal behavior of a heat-storage floor heated by an air flow.** Saastamoinen, J.J. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Thermal Engineering). 1988. 143p. NTIS, PC E06/MF A01.

A heating system based on the circulation of air through a wall or a floor is considered theoretically. The energy consumption of a building can greatly be decreased throughout the year. The energy demand decreases during the spring and the autumn due to the solar heat without essential additional expenses. During the winter, the energy consumption can greatly be decreased by the intensification of the intermittent heating. During the summer, the energy consumption of the building can be decreased by storing the renewable cooling energy of the cooler nights for the day. The low temperature level of the heating system is also advantageous in connection with the district heating, the heating with biomass fuels, in heat-pump heating and the solar heating. It is easy to add an electronic filter in the air-based heating system, and the need for ventilation can be decreased, which causes additional savings. A computer program applicable for microcomputers is developed.

14985 **(PNL-SA—16442) Building energy conservation research projects being conducted at Pacific Northwest Laboratory, 1988.** Parker, G.B. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 53p. (CONF-8811142—1). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004354/JAW.

From Housing for the 90's trade show and conference; Tacoma, WA, USA (30 Nov 1988).

One focus of these programs is to develop whole building design guidance to enable architects and engineers to incorporate energy concerns into buildings during the early stages of design. A second focus is to understand building energy use relationships through detailed end-use energy monitoring to develop building operation and retrofit strategies, as well as, to support the design guidance area. A third focus is to conduct programmatic assessments and focused technical analyses to support program development and management information needs. Program activities include data base development, examination of market behavior and economic factors, program planning and implementation requirements, and technology appraisals. This document is organized by program funding organization: Section 2 contains programs conducted for the US DOE Office of Buildings and Community Systems; Section 3 contains the US DOE, Federal Energy Management Program; Section 4 contains the US Department of Housing & Urban Development; Section 5 contains programs conducted for the US DOE Bonneville Power Administration; Section 6 contains the US Air Force Dining Hall Project conducted for the US Air Force Engineering and Services Center; Section 7 contains programs conducted for non-federal organizations that include the Gas Research Institute and the State of Idaho.

14986 **(SC—7909) A survey of moisture problems in thermally upgraded existing houses.** (Scanda Consultants Ltd., Ottawa, Ontario (Canada)). 1979. 151p. (CE—02236). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An attempt was made to find cases in which thermal upgrading of existing houses in Canada had led to moisture problems, and to catalogue the types of problems encountered and their causes. This was done primarily by a national telephone survey of insulation contractors, companies and public agencies likely to be contacted by homeowners experiencing problems, and some individual homeowners. Based on the information gathered by telephone interviews and visits with the 52 cases that were found to have problems related to retrofitting of insulation, house characteristics and suspected causes were cross-tabulated. Observations from this study revealed the following. There was a mild correlation between age of house and certain kinds of problems (e.g. moisture in exterior walls in older houses). The problems tend to appear soon after the upgrading work is done, and tend to be associated with high humidity levels in the house. Leakage of warm moist air from the house interior into the building shell is a major cause of condensation problems. Lack of ventilation of roof spaces is a less important cause of problems than air leakage, but is still significant. Significant upgrading leads to increased interior humidity. Most agencies, contractors and homeowners contacted had no awareness of the role played by air leakage in causing condensation problems. However, it is also concluded that the incidence of moisture problems is likely less than 2% of the upgraded houses. 47 figs., 5 tabs.

14987 **(TKK-KO/LVI—B20) Influence of ventilation and air distribution on the airflow field.** Kovanen, K.; Majanen, A.; Siren, K. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1988. 146p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756307/JAW.

The influence of ventilation and air distribution on the airflow field in dwellings and offices has been investigated. The study was accomplished by making field measurements in 37 spaces with most typical ventilation and air disribution systems. In addition, the characters and differences of the displacement and mixing air distribution has been studied by laboratory measurements in a large modelhall and in a small testroom. In systems with celing or windowbench diffusers the mean velocities were approximately equally at every height. Instead in systems with floor diffusers or wall registers or with mechanical exhaust with supply to hall the highest mean velocities were observed near the floor. In the dwellings the highest mean velocities were observed near the floor regardless of the ventilation system. Generally in the dwellings the mean velocities were obviously lower than in the offices. With all air distribution systems but the system with mechanical exhaust with supply to hall the turbulence intensities increased when the distance from the floor increased. However, the connection with the turbulence intensities and measuring height was obviously smaller with systems weith ceiling diffusers than with wall registers. Obvious differences between the displacement and mixing air distribution systems were observed. The mean velocities and turbulence intensities at the floor level were higher with the mixing system than with the displacement one. In addition, remarkable differences between the devices of separate manufacturers were found.

14988 **(TKK-KO/LVI—B21) Impact of the surface temperatures on thermal comfort in living- and office-rooms literature review.** Palonen, J.; Majanen, A. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1988. 40p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756308/JAW.

The published results of the studies on surface temperatures' impact on comfort were reviewed. The example calculations were made. Where applicable, the criteria of 10 and 20 percent of dissatisfied were used; otherwise the values obtained from thermal comfort standards were applied. The optimal temperature ranges and target - temperatures given by standards for floor surfaces are presented. The effects of the floor material, occupance time and footwear on the recommended temperatures were reviewed. The relations between the percentage of dissatisfied and the radiant asymmetry, determined in experimental studies, are presented for warm and cold surfaces both horizontal and vertical. The percentage of dissatisfied as a function of temperature difference between the surface and the room air temperature is presented for the case of warm ceiling and cold wall or window. The surface temperatures related to acceptable radiant asymmetry can be calculated for the case at hand provided that the dimensions of the room and the surface are known. The principle of the calculation method is explained. The examples for determining the maximum acceptable temperatures of the ceiling and the radiator surface are presented.

14989 **(TTKK-LT—48) Zeotropic binary refrigerant mixtures in air cooling coil.** Aittomaeki, A. (Tampere Univ. of Tech. (Finland). Thermal Engineering). 1985. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756309/JAW.

A special installation for testing binary regrigerant mixtures in an air cooling evaporator was built. The influence of the main coil dimensions on the performance were studied using mixture R22/R114 and as a comparison basis pure R22. Results are compared to performance values with a brine evaporator.

14990 **(TTKK-LT—58) Zeolite/methanol - the adsorption heat pump.** Haerkoenen, M. (Tampere Univ. of Tech. (Finland). Thermal Engineering). Feb 1988. 142p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756310/JAW.

This work deals with adsorption heat pump processes. The adsorption process was studied both theoretically and experimentally. Experiments were carried out using different types of synthetic zeolites as an adsorbent and methanol vapor as an adsorbate. Adsorption equilibrium curves were determined, heat of adsorption was measured calorimetrically and sorption kinetics was studied. The pump process was tested experimentally using the pairs 5A/CH/sub 3/OH, 13X/CH/sub 3/OH and 5A/H/sub 2/O. In order to study the effect of various parameters on the process, a simple numerical simulation model was developed and tested.

14991 **(TVA/OP/EDT—88/25) Radiant barrier testing to assess effects of dust accumulation, attic ventilation, and other key variables.** Hall, J.A. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Jul 1988. 46p. NTIS, PC A03/MF A01 - OSTI. Order Number DE89006441/JAW.

This report summarized the work accomplished during the fifth season of testing at TVA's EUTF. Previously, tests were conducted at the EUTF during the 1985/1986 summer and winter and the 1986/1987 summer and winter. This previous work at TVA, and work at the University of Mississippi, the FSEC, Texas A and M, and ORNL, have shown that in the summer: all RB installation locations provide large reductions in ceiling heat flux when used with R11 and R19 fiberglass, cellulose, or rock wool; reductions in ceiling heat flux from RBs when used with R30 are not nearly as large as from RBs when used with R19; the RBR and RBT provide sizable reductions in whole-house cooling loads; and the RBT provides the largest reduction in ceiling heat flux in most cases. Previous work has shown that in the winter: the RBT provides moderate ceiling heat flux reductions and whole-house heating load saving with R11 and R19 fiberglass, cellulose, or rock wool; the RBR shows very little reduction in ceiling heat flux in most cases; and reductions in ceiling heat flux with R30 are usually much less than with R11 or R19 insulation. 12 refs., 14 figs., 11 tabs.

14992 **(VE—7904) Study of energy consumption of office buildings. Vol. 2. A test of the energy simulation program.** (Vinto Engineering Ltd., Edmonton, Alberta (Canada)). 1979. 83p. (CE—02237). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study provided some insight into the relationship between a number of variables and the energy consumption of typical office buildings. The problems inherent in studying the effects of these variables in actual office buildings were readily apparent. However, with the aid of computer simulation, the effects of the variables on energy consumption could be determined. The Energy Systems Analysis program developed by Public Works Canada, the Meriwether program, provided the means of modelling buildings. However, since the results obtained were dependent on the degree to which the program could replicate actual situations, the validity of this method was established prior to undertaking the study. The results of the simulations of the four buildings form the basis for the following conclusions, which support the validity of the computer model for the examination of energy consumption in existing buildings. It is possible to successfully simulate consumption of actual annual energy use within a tolerance of +/- 10%. The error tolerance can be achieved while maintaining acceptably close month-to-month correspondence in energy use. The simulation can be achieved without making assumptions inconsistent with known building construction, operation and occupancy parameters. Energy analysis is made more efficient and accurate when the following information is readily available: air balancing and adjustment report, maximum kilowatt usage of major equipment, load profiles of major systems and building use patterns, and details of operating procedures and philosophy of system management. Therefore the Meriwhether program may be considered as accurately modeling energy usage in office buildings over a wide range of energy consumptions given that the input data is accurate. 23 figs., 9 tabs.

14993 **(VE—7904) Study of energy consumption of office buildings. Vol. 1. Synopsis and Part 8, application of the results from Vol. 3, investigation of building parameters.** (Vinto Engineering Ltd., Edmonton, Alberta (Canada)). 1979. 116p. (CE—02238). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The basic objectives of this National Research Council of Canada study were: to establish the reliability of an energy simulation program in predicting energy consumption, (four existing buildings for which energy consumption data were available were simulated by the program, and the results compared to actual consumption data); to analyze the effects of climate, size, shape and period of occupancy of the energy consumption of a typical office building; and to investigate the potential for reductions in the energy consumption of existing buildings, through the application of a pre-determined, low-cost energy management program for the four existing buildings. The focus is primarily exploratory, with direction obtained through a review of available related research, mechanical engineering theory, and relevant experience. This study attempts to eliminate those variables that do not have a significant effect on the level of energy consumption, and to provide insight into the relationship between the level of energy consumption and the level of these variables. The study has been segmented into a number of volumes; volume one provides a summary of the overall study results, incorporates the essential elements of computer simulations, and provides statements of results obtained. It also provides a description of the difficulties encountered in simmulating the actual energy consumption of existing buildings. 16 figs., 21 tabs.

14994 **(VE—7904) Study of energy consumption of office buildings. Vol. 4. Investigation of energy management measures.** (Vinto Engineering Ltd., Edmonton, Alberta (Canada)). 1979. 101p. (CE—02220). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulations were carried out of four office buildings, three in western Canada and one in Seattle, in order to test various energy conservation measures applied to those buildings. Base energy consumption was simulated using data from a test reference year. Twelve energy conserving measures, which should be applicable to most buildings, were selected: reduction of minimum outdoor air quantity, shutdown of mechanical/electrical systems, unoccupied temperature reset, adjustment of thermostat settings, humidification and dehumidification, adjustment of lighting levels, ambient reset of supply air temperature, demand reset of supply air temperature, domestic hot water temperature reduction, cooling with outdoor air, air flow rate reduction, and lower condenser water temperature. For each building, alternatives were grouped into items that had no cost to implement (system operating changes) and those that had some cost, e.g. addition of control devices. The no-cost items were simulated as if they were implemented simultaneously, thus establishing a new base energy consumption. Alternatives that had costs were simulated sequentially and ranked in order of increasing technical difficulty and cost. The objective was to show what could be achieved in energy savings with only minor capital expenditures. The simulation results clearly indicated that significant energy savings are available through low-cost revisions. Although there were variations in specific results provided for various measures, the measures were extremely effective in reducing energy consumption in the simulated buildings and were particularly attractive in the case of the no-cost revisions. 35 refs., 8 tabs.

14995 **(VE—7904) Study of energy consumption of office buildings. Vol. 3. Investigation of building parameters.** (Vinto Engineering Ltd., Edmonton, Alberta (Canada)). 1979. 96p. (CE—02214). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study was undertaken to determine the influence of climatic conditions, building size, shape, and hours of use on the energy consumption of new Canadian office buildings. A model building, based on an existing 12-story unit, was designed for computerized simulation. Weather data for four cities across the country were used to model a test reference year for each location, and various climatic variables were changed while holding other factors constant. An increase in heating degree days resulted in an increase in heating requirements, and cooling and heating degree days accounted for 92% of the variance in energy consumption. To study size effects, storeys of equal area were added to the model, and various building loads were changed while holding other factors constant. The results showed a small increase in energy consumption per unit area as the size increased; this could be due to an increased air infiltration rate. In studying shape effects, the ratio of wall envelope to floor area was varied (other factors constant) with various building loads as variables. An increase in that ratio resulted in an increase in energy consumption; some variance in the results could have been due to changes in the air infiltration rate. In examining the effects of hours of use on consumption, it was found that when days of operation were held constant, energy consumption increased with increased usage periods. For a constant usage period, energy consumption increased as days/week increased. Results from these simulations are used to produce equations for predicting the level of energy consumption attainable for an office building within most areas of Canada. 35 refs., 21 tabs.

14996 **(VTT-TIED—702) Prefeasibility study on cool storage systems.** ElMahgary, Y.; Kekkonen, V.; Laitinen, A.; Pihala, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Laboratorio). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Apr 1988. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756311/JAW.

From the overview undertaken it was realized that cool storage systems have already been commercialized in the USA and in few countries in Europe. In the USA they were, however, mainly applied to air conditioning systems. Cool was stored in the form of both sensible and latent heat. In Europe the trend was to use cool storage in connection with commercial refrigerating cycles which were based mainly on storing the cool in eutectic solutions in the form of latent heat of fusion. Both continuous and intermittent operations were considered. Cool storage in Finland has considerable potential particularly for continuous operation cycles which operate with smaller refrigerating units thus implying less investment costs for both the refrigerating and cool storing systems. This is, in addition to the savings, due to producing part of day-time energy with night tariff. On the other hand, intermittent operation in which all the cool is produced during the night and used in the day-time is not cost effective in Finland. The third alternative studied was to provide existing refrigerating units with a cool storage system. This alternative was cost-effective only if the cool was stored in the form of latent heat in suitable eutectic solutions. Technically it is possible to store nature cool and to use it in improving the performance of the refrigerating cycle, in resulting substantial energy savings. Several systems and solutions exist that benefit from natural outdoor cool. A comprehensive cost-effectiveness study should, however, be undertaken on these systems and solutions. Among the points which need further development and investigation are the combined storage of heat and cool, cool storage systems for the domestic sector and the use of optimal storing media and reservoirs for a given cooling temperature.

14997 **(VTT-TUTK—545) Controllability study of unit processes of air conditioning.** Marjamaeki, P.; Katajisto, K.; Kohonen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1988. 121p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756314/JAW.

The analysis of the dynamic behaviour and controllability should form the basis for the control of HVAC-system. The objective of the study was to examine the dynamic behaviour, the controllability, the choice of control law and the adjustment of the control parameters by step-response method. Studies were made to an open-loop system, i.e. a controller was not connected. Furthermore, the applicability of the parameters was analyzed by studying the transient behaviour of the closed-loop systems. The simulation package HVACSIM was used. It is designed to allow detailed simulation of entire building systems: the heating, ventilating and air-conditioning systems, the building shell, the physical plant and the dynamic interactions among these subsystems. The characteristic curve and the gain of unit processes of air-conditioning system were determined as a function of the actuator position. Depending on the design of the process the gain varies greatly. However, from the control technical point of view the gain of a closed-loop system should be kept constant. The process should be designed and dimensioned in a way that the process gain varies as little as possible. Overdimensioning of a system makes its controllability worse. In addition, valve and damper authorities should be as big as possible. The stability of the control loop can be ensured by choosing the proportional gain according to step-response with greatest gain factor. Generally, the parameters of conventional PI-controller can be determined rather accurately by step-response method. If the process gain varies greatly one possibility could be the use of advanced control algorithms: a nonlinear or an adaptive control algorithm. Research will be continued by studying the control of the whole system formed by room space and air-conditioning system. Furthermore, advanced control algorithms will be developed.

14998 **Integrated analysis of demand-side programs.** Eto, J.H.; Koomey, J.G.; McMahon, J.E.; Kahn, E.P. (Applied Science Div., Lawrence Berkeley Lab., CA (US));. *IEEE Transactions on Power Systems;* **3**: No. 4, 1397-1403(Nov 1988).

The authors use a case study of residential appliance efficiency standards in the Nevada Power Company service territory to illustrate an integrated method for evaluating the load shape and economic impacts of demand side utility programs. The method consists of four models: the LBL Residential Energy Demand Model, the DOE-2 Building Energy Analysis Model, the LBL Residential Hourly Load and Peak Demand Model, and the LBL Utility Financial Impact Model. Load impacts are modeled from the "bottom-up" with end-use energy and hourly demand models. Benefits are calculated with the aid of a production cost model and methods adapted from avoided cost offers to cogenerators and small power producers. The analysis of avoided production costs explicitly considers perturbations in future supply plans resulting from demand-side load modifications. Utility and societal costs are compared to the benefits of appliance standards.

14999 **(DOE/CE/64869—T1-App.A-Pt.2) Energy survey study and report of hospitals in Chicago: Saint Anthony Hospital: Appendix A: Part 2, Final report.** (Consulting Consortium, Inc., Chicago, IL (USA)). Aug 1988. Contract FG01-86CE64869. 133p. NTIS, PC A07 - OSTI. Order Number DE89006837/JAW.

This study is part of a three-phased demonstration program to reduce energy consumption in hospitals through practical life-cycle/cost-effective modifications and alterations. Funds for the demonstration program are being provided by the American Hospital Association (AHA), the Department of Energy (DOE), and the Department of Health and Human Services (DHHS). A thorough study and evaluation of all building systems is made to identify the most cost effective approaches to energy conservation. The primary objective of the study is to investigate and analyze energy usage of the facility and to identify all life cycle, cost-effective changes required to effect a reduction in energy consumption. On November 2, 1987, Consulting Consortium, Inc., was instructed to proceed with this analysis. Initial meetings were arranged with the hospital administrators to convey the purpose of the study and to request utility billing data, small scale floor plans of the facility, and to arrange for engineering walk-through surveys. The survey at St. Anthony was initiated on December 8, 1987. This report summarizes the findings together with data and information gathered during the course of that visit and other subsequent visits. This

report describes the architectural, mechanical and electrical systems of the Saint Anthony Hospital. In addition, an analysis of the base year energy usage as derived from utility bills and statement of the current energy consumption trends for the hospital, and a list of recommendations for reducing energy consumption is included.

15000 **Determinants of measured energy consumption in public housing.** Greely, K.M.; Mills, E.; Goldman, C.A.; Ritschard, R.L. (Lawrence Berkeley Lab., Applied Science Div., Energy Analysis Program, Univ. of California, Berkeley, CA (US));. *Energy Systems and Policy;* **12**: No. 1, 13-32(1988).

In this study, the authors used a two-part methodology to analyze metered energy use patterns in 91 public housing projects. Their goal was to develop a technique that could be used by the U.S. Department of Housing and Urban Development (HUD) and public housing authorities (PHAs) to derive reasonable energy use guidelines for different segments of the public housing stock. In the authors' approach, actual energy use was first normalized to consumption in a year with "typical" weather and then used in a multiple regression analysis of different cross-sectional variables. The regression model explained 80% of the variation in energy use, with the type of account and the management practices of PHAs emerging as important explanatory factors. As compared to previous engineering estimates of public housing consumption, the projects in this study used 8% (per square foot) to 16% (per apartment) less fuel and electricity, but consumption was still significantly higher (43%) than that of privately owned multifamily housing. They conclude that this methodology could be used to help HUD and PHAs increase their understanding of energy use patterns and appropriate consumption levels in public housing.

15001 **Supplement to an analysis of monthly sales of natural gas to residential customers in the United States.** Herbert, J.H.; Kreil, E. (Energy Information Administration, U.S. Dept. of Energy, Washington, DC (US));. *Energy Systems and Policy;* **12**: No. 1, 43-46(1988).

Residential natural gas demand for the United Staes between 1979 and 1984 is examined. A very reliable regression equation is estimated which equation is used for calculating conditional forecasts and a variety of load statistics. Attention to data issues is once more seen to result in improvements in knowledge of market conditions and in the specification of a behavioral equation.

15002 **Building design.** Verderber, R.; Morse, O.; Jewell, J.E. (Lawrence Berkeley Lab., Applied Science Div., Berkeley, CA (US));. pp v of The 1987 IEEE Industry Applications Society annual meeting. Parts 1 and 2. Conference record. Piscataway, NJ; IEEE Service Center (1987). (CONF-871065—).

From 22. IEEE/IAS annual meeting; Atlanta, GA, USA (19 Oct 1987).

This paper discusses the unique features of a multistory office building that successfully permit most of the space to be daylighted and the electric lights to be dimmed by a cost-effective centralized system. This system includes: the use of light shelves, sloped ceilings, and proper building orientation and symmetry, and supplies only the ambient illumination. Measurements of the daylight illumination levels and the performance of the lighting control system indicate that daylighting can provide over 70% of the required ambient illumination through the year. Based on the installed cost of the lighting control system, its payback period if 2.2 years.

15003 **The effects of interior room cavity obstructions on the illuminance distribution characteristics in task-station applications.** Siminovitch, M.; Navvab, M.; Rubinstein, F. (Architecture and Planning Research Lab., Univ. of Michigan, Ann Arbor, MI (US));. pp v of The 1987 IEEE Industry Applications Society annual meeting. Parts 1 and 2. Conference record. Piscataway, NJ; IEEE Service Center (1987). (CONF-871065—).

From 22. IEEE/IAS annual meeting; Atlanta, GA, USA (19 Oct 1987).

This paper describes the effects that representative room cavity obstructions have on the ability of a general lighting system to provide a specified design illuminance. The work was done in response to the perceived deficiency associated with the traditional zonal cavity technique which is limited to the modeling of spaces with unobstructed room cavities. This limitation can result in unexpected reductions of task illuminance in comparison to illuminance levels originally specified in the design process. Task stations and partitions were physically modeled using scale model photometry techniques in order to identify the potential reduction of task illuminance. Task illuminances were measured for a range to typical interior geometries and lighting layouts. These task illuminances were compared with those obtained using an unobstructed interior room cavity condition. Experimental results show that typical interior obstructions can reduce the design illuminance by as much as 20 to 30% when compared to the unobstructed cavity conditions. This study also examined the effects of task station geometry on the contrast of a standard visual task. Experimental data indicates that furniture systems tend to occlude the veiling contribution from fixtures mounted within the offending zone.

3202 Transportation

REFER ALSO TO CITATION(S) 15645, 15645, 15649, 15651, 15652, 15908, 16834

15004 (EMR—9008, pp 20) **Dimensions of consumer response to increasing gasoline prices. The experience of the seventies.** Pitts, R.E.; Willenborg, J.F.; Sherrell, D.L. (Univ. of Notre Dame; Univ. of South Carolina). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This study examines consumer response to increasing gasoline prices in the USA from 1973 through 1979, with particular emphasis on the 1975-1979 period. The major purpose of this study is to further understanding of how people have reacted to the increasing price of gasoline in an environment of perceived energy shortages in many different components of society. A sample of urban residents was surveyed, and factors underlying behavior relative to change in miles driven and in downsizing vehicles were identified and measured. In addition, people were classified into groups on the basis of adaptive or adjusted behavior, and the characteristics of those groups were examined. The findings of the study indicate that consumers do exhibit distinct patterns of behavior related to automobile usage. These patterns are identifiable and somewhat predictable using demographic and personality variables as explanatory factors. The adaptive behavior group profiles suggest that the determinants of behavior are complex, including both situational determinants and more stable, deeply held personality characteristics (value systems). Generally, gasoline price increases do not discourage driving, except among certain financially disadvantaged segments. Policy and planning implications of the study findings are also discussed. 11 refs., 8 tabs.

15005 (EMR—9008, pp 24) **Energy for travel: household travel patterns by life cycle stage.** Zimmerman, C.A. (Yale Univ., New Haven, CT, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper examines the variation in household travel to determine the magnitude of demand for energy for travel in the USA. The life cycle approach is presented as a potentially useful framework for describing the travel behavior of households and for assessing the impact of future energy conditions in the household sector. A cross-sectional survey of 17,949 households throughout the country was used in the empirical analysis of travel behavior by life cycle stage. In addition to trip data, other information was obtained about individual members and for the household in general. From the socio-demographic descriptions, each household was categorized by stage in the family life cycle. Variations in travel over the family life cycle were analyzed by comparing measures of

travel reported by households in each stage of the cycle. In additional to the typical family life cycle, four alternative life cycles were examined: the single parent cycle, the childless couple cycle, the single person cycle, and the cycle of unrelated individuals. The life cycle approach, with certain modifications, was found to be a useful tool in empirical research, having the advantage that it helps clarify the nature of change over time in family composition, material resources, behavior patterns, and the relationship among these components of change. For household travel behavior, variations over the life cycle have been shown to exist for both the typical and alternative patterns. For some trip purposes, the life cycle effect appears to be more important at some points than at others. 30 refs., 3 figs., 5 tabs.

15006 (EMR—9008, pp 16) **Report on the passenger car fuel consumption survey.** Sorrenti, K.; Petherick, T. (Statistics Canada). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

A survey program was formed to establish a national data base concerning personal use of the passenger car in Canada which would contain the following information: total distance travelled, total amount of fuel consumed, average distance obtained per unit of fuel, total expenditures on fuel, and seasonal fluctuations in fuel consumption and in distance travelled. Among the needs to be served by the data base would be the monitoring of passenger car fuel economy standards and the estimation of fuel requirements in fuel shortage conditions. This paper describes the survey methodology and data analysis procedures, and includes some of the data collected. The sample design was based on selecting a sample of car drivers from provincial motor vehicle registration lists. A pretest was conducted to evaluate this method and to indicate the sample size required for achieving the necessary number of mailouts of a diary to be filled out by the driver. In conducting the actual sampling, three monthly stratified random samples are selected, and are screened to exclude any vehicles not included in the target population of personal-use passenger cars. Data collection uses a combination of telephone interviews and mailing the diary used to record fuel purchases and other data. In general the methodology has proved successful in satisfying the data requirements of the survey program; some areas for improvement are discussed. 8 tabs.

15007 (N—89-12565) **Advanced turboprop project.** Hager, R.D.; Vrabel, D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 130p. (NASA-SP—495; NAS—1.21:495; LC—88-1690). NTIS, PC A07/MF A01.

Original contains color illustrations.

At the direction of Congress, a task force headed by NASA was organized in 1975 to identify potential fuel saving concepts for aviation. The result was the Aircraft Energy Efficiency (ACEE) Program implemented in 1976. An important part of the program was the development of advanced turboprop technology for Mach 0.65 to 0.85 applications having the potential fuel saving of 30 to 50 percent relative to existing turbofan engines. A historical perspective is presented of the development and the accomplishments that brought the turboprop to successful flight tests in 1986 and 1987.

15008 (NP—9770212) **Simulation of a dc rail system for the determination of energy consumption.** Diep Dinh Ngoc; Biella, W. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Allgemeine Elektrotechnik). 1985. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770212/JAW.

The operation management of traction systems for short-distance urban traffic is distinguished by rapidly changing speeds of the trains in use. The requisite short-distance journeys require a great deal of energy due to the frequent stops with motor-power units with conventional propulsion in braking the trains, this energy was converted into heat by means of mechanical braking or electrical resistance braking. The development of propulsion technology opens up, nowadays, new possibilities of saving energy, e.g. through regenerative braking with storage or feed-back of brake energy. The drawing-up of a simulation program on the basis of an exact, universally valid model therefore provides the prerequisite for the continuing examination of possible energy conservation. The development of the simulation software should proceed from the simulation of a section of the traction train to the development of the program to a possible examination of complete traction tracks. Beginning with a brief description of the network and vehicle models on the basis of the simulation program, the structure and operational possibilities of the program are presented. Using the example of a simulation, the efficiency of the program is then documented.

15009 (NP—9770215) **Effects of traffic-influencing measures on exhaust emission and fuel consumption.** Benz, T.; Brannolte, U.; Rowold, K.J. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Verkehrswesen; Umweltbundesamt, Berlin (Germany, F.R.)). Jun 1986. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770215/JAW.

The paper deals with traffic measurements on motorways and urban street networks, and with the measurement evaluation of individual trips under certain driver and vehicle conditions. Three modes of driving behaviour were chosen, according to scientific criteria, namely aggressive, normal, and defensive driving behaviour, and three different types of cars (powerful engine, medium and low-powered engine). The investigations were performed on selected road stretches of the Federal Autobahn network in the Rhein-Main area and on highly loaded urban streets in Frankfurt/Main. A complementary study was carried out to compare the measured speed distributions with other available distributions which are supposed to be of general validity for the motorway network. The investigation also includes the modelling of traffic flows by means of simulation to compute exhaust emissions and fuel consumption. Stretches of Federal motorways and major urban streets with and without traffic signals are investigated by use of these techniques. The results obtained for the carbon monoxide and nitrogen oxides and the fuel consumption are given for the various parameter combinations and also expressed as means weighted by vehicle miles. (orig./UA) With 9 refs., 20 tabs., 25 figs.

15010 (PB—89-127898/XAB) **Impacts of carpool utilization on the Katy Freeway transitway 30-month after evaluation. Interim report, September 1984-April 1988.** Christiansen, D.L.; McCasland, W.R. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Sep 1988. 62p. (TTI—2-10-85-484-7). NTIS, PC A04/MF A01.

See also PB—87-187852.

A major commitment has been made in the Houston area to develop physically separated transitways in the medians of freeways. The lanes are reserved for high-occupancy vehicles. Phase I of the first completed transitway opened on the Katy Freeway (I-10) in October 1984. Phase 2 opened in June 1987. To increase potential utilization of the facility, carpools began using the transitway on a test basis in April 1985. The research study, funded jointly by the Metropolitan Transit Authority of Harris County and the Texas State Department of Highways and Public Transportation, was initiated to undertake a comprehensive analysis of the effects of permitting carpool utilization. The report documents the data collected in October 1987, 2.5 years after carpool utilization of the transitway was permitted. In the report, these data are compared to similar data collected both before carpool utilization was permitted and on several occasions after carpool utilization was permitted.

15011 (PB—89-130991/XAB) **Elderly and disabled transportation plan for the Merrimack Valley.** (Merrimack Valley Planning Commission, Haverill, MA (USA)). Sep 1987. 115p. NTIS, PC A06/MF A01.

This report explores ways to meet the transportation needs of elderly and disabled people in a number of communities north of Boston, Massachusetts. The study uses a process which appears to have broad applicability in other jurisdictions. It examines the demographics in the communities involved first, projecting them into the future. It then conducts a detailed inventory of transportation services, including services for the general public and special users provided by the local transit authorities, private nonprofit services

for special users, and privately provided services. Conducting a community-by-community review, the process notes overall levels of demand, concentrations of special users and their destinations, and the location of transportation routes relative to them. It then recommends new services or alterations to existing services to remedy present or future mismatches. The report should be of interest to transportation planners in communities of all sizes.

15012 **(QU/CIGGT—80-3) Comparative assessment of alternative energy sources for railway application. Development of Alternatives and evaluation approaches.** Bunting, P.M. (Queen's Univ., Kingston, Ontario (Canada). Canadian Inst. of Guided Ground Transport). 1980. 107p. (CE—02257). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The immediate objectives of this study were to characterize alternative energy options, define an evaluation methodology and to review the U.S. Alternative Fuels for Medium Speed Diesel Engines (AFFMSDE) program in relation to identified study requirements. Because it was established as a first stage of a larger analytical effort, recommendations are related to research or study, not to specific implementation of energy options. These recommendations are expressed for convenience under subheadings that address first Canadian requirements and secondly the opportunities for participation in joint U.S./Canadian work. The two types of recommendations are related. Specific attention should be paid to a range of R&D options which may be useful in the short and near term. Because of the urgency of the problems faced, existing fuels/engines work should not be delayed and should perhaps be expanded to include other fuel/engine combinations (hydrogen diesel, fuel cells, etc.) Early research, in cooperation with U.S. agencies, should aim at specification of liquid, gaseous and blended fuels to define what is available and to explore the potential of some feedstocks. Engine testing on those fuels should follow to determine tolerance to fuel property adjustments and to explore engine system changes which would extend the range of tolerance. Development of one or more of the major longer-term energy source technological options such as fuel cells, batteries or hydrogen fuel should be pursued because shorter-term actions may prove insufficient to meet future railway energy demands. Development and evaluation of the railway electrification option for main lines is an option requiring relatively less new technological development and offering the potential for early use of a wide range of alternative fuels.

15013 **(TC—7807) Rail R&D projects.** (Transport Canada, Ottawa, Ontario. Research and Development). 1979. 113p. (CE—02209). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes ongoing and planned Canadian transportation research and development projects reported by government departments and agencies. The general field of investigation covered by this volume is the rail mode and relate infrastructures. Information given for each project includes names of participating agencies, personnel, project description, purpose of project, and starting/completion dates. Specific project topics include railway geotechnical research, communications and control systems, energy conservation in intercity transport, energy efficiency in intermodal freight services, railway electrification, energy consumption monitoring, coal transport, alternative locomotive engines and fuels, railway switch protection, and improved freight car technology.

15014 **(TC—7907) Road R&D project.** (Transport Canada, Ottawa, Ontario. Research and Development). 1979. 159p. (CE—02208). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes ongoing and planned Canadian transportation research and development projects reported by government departments and agencies. The specific field of investigation is the road mode, including vehicles and related infrastructure. Information given under each project includes names of participating agencies, personnel, starting and completion dates, purpose of project, description of project, and anticipated impact. Specific projects include electric vehicles, energy efficiency, urban transport systems, vanpooling, alternate energy sources for transport, analysis of industrial location implications for transport energy requirements, transport and storage of hazardous energy commodities, hybrid vehicles, improved materials for automobiles, lubricants, computerized vehicle routing, insulation of highways over permafrost, design of bridges and highways, and cost analysis of alternative urban transportation programs.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 14181, 14229, 14231, 14339, 14495, 14495, 14839, 14846, 14852, 14960, 15951

15015 (EMR/E—1976, pp 69-71) **Canadian coal for the Canadian steel industry?.** Layt, G.H.G. (The Steel Co. of Canada). 1976. (CONF-8609466—; CE—02127).

From 28. Canadian conference on coal; Ottawa, Canada (26 Sep 1986).

Recent developments are discussed which may have some influence on coal consumption by the Canadian steel industry. This industry is characterized by an extensive use of the coke oven/blast furnace process and a dependence on metallurgical coal as an energy source. The developments discussed are: optimization of conventional cokemaking; coal preheating; and formed coke. Partial briquetting is seen as offering the best solution to maintaining or improving the strength of coke made from coals available now or in the foreseeable future. Coal preheating prior to charging offers the significant advantage of allowing the maintenance of coke quality when using lower quality coals. Formed coke, which may become increasingly necessary with future cost increases of coking coals, uses cheaper low-rank coals for coke manufacture. Processes to make formed coke currently involve high capital expenditures and risks, and it is unlikely that formed coke will replace oven coke significantly in Canada over the next 5 years. An overall conclusion presented in this paper is that the optimization of conventional cokemaking is the best approach to compensation of shortfalls in coking coal supplies. The paper also reports on the direct reduction of iron ore using solid fuels; successful adoption of this process would have a major impact on the type of coal required by the industry. In addition, trends in the US coal industry are discussed as they relate to imports by the major Canadian steel Unstable labor conditions, low productivity, and possible government concern over availability of metallurgical coal are felt to indicate a need for contingency plans to develop alternate Canadian coal sources.

15016 **(EPRI-EM—5996) Power utilization in flat processing of steel: Final report.** Roberts, W.L. (Electric Power Research Inst., Palo Alto, CA (USA); EPRI Center for Metals Production, Pittsburgh, PA (USA)). Jan 1989. 152p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006676/JAW.

A study has been made of the current electrical requirements in the flat-processing operations of the domestic steel industry and how these might be influenced by technological developments occurring within them. Electrical power is consumed mainly by the hot rolling of strip (about 120 kWh/ton), cold reduction (about 125 kWh/ton) and finishing operations (about 125 kWh/ton). No significant changes in total energy consumption are likely to result from the current revamping of facilities or changes in operating practices. The hot rolling of thinly cast strip to cold-rolled sheet gages under scale-free conditions could obviate the processing steps of pickling, cold-reduction, cleaning and annealing. The successful development of such technology would not only eliminate the conversion costs of these four operations but would probably reduce electrical power utilization by 50 to 100 kWh/ton. It is therefore suggested that EPRI may wish to further explore the technical and economic feasibility of such hot-rolling practices, as well as investigate the use of (1) magnetostrictive devices for automatic gage control, (2) intense magnetic fields for control of the crystallographic texture during annealing and the thermal conduction within the strip during heating and cooling, (3) linear motors for strip propulsion on various processing lines, and (4) a-c motors for mill-stand and roller-table drives. 198 refs., 70 figs., 25 tabs.

15017 **(GRI—88/0051) US industrial process heating energy consumption: 1985.** McDermott, H.; Chapman, M.A. (Gas Research Inst., Chicago, IL (USA); Hagler, Bailly and Co., Washington, DC (USA)). Feb 1988. 215p. NTIS, PC A10/MF A01. Order Number TI88013007/JAW.

The objective of this report was to refine and update energy-use estimates for US industrial process heating based on categories defined in an earlier study sponsored by Gas Research Institute (GRI) (Report No. GRI--84/0187. 154 refs., 77 tabs.

15018 **(ISI-B—17-88) Demonstration of an integrated energy concept for waste water treatment plants.** Hillenbrand, T.; Kunz, P.; Boehm, E.; Toussaint, D.; Schlicher, A. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1988. 147p. (In German). NTIS (US Sales Only), PC A07. Order Number DE88756624/JAW.

A reduction of energy costs is fundamentally not only possible through a reduction of consumption but also through load shifting. Besides organizing measures, electrical load peaks can be prevented by load management systems. The completed survey shows that through special load-shedding programmes considerable savings in electricity costs (a reduction of the maximum electricity consumption by approximately 10%) are possible for waste water plants. Before the installation of such systems an energy demand analysis must be carried out. The results of such an analysis not only can be used for load management but can also build the foundation for an integrated energy concept with actual opportunities for energy conservation and a minimization of electricity supply costs. Such a concept is shown by the example of one waste water plant. (orig.) With 26 refs., 31 tabs., 70 figs.

15019 **(MA—7811) Waste paper recycling opportunities for government action. Vol.4, corrugated waste. Final report.** Bailey, J.; Love, P. (Middleton Associates, Toronto, Ontario (Canada)). 1978. 91p. (CE—02207). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study analyzes current and expected corrugated waste market conditions in Canada, with the objective of identifying government initiatives which could permanently increase recovery levels. Short-term, practical measures are featured. National and regional demand, generation and recovery levels are examined, along with imports and exports to the USA. Over 70% of corrugated waste is consumed in Ontario and Quebec, and most of this waste is generated in those two provinces. Average recovery rates in most major urban areas are estimated at 30-40%. Future demand, generation, and recovery are estimated, and it is suggested that there will be enough domestic demand to permit reclamation of nearly 35% of Canada's total corrugated wastes. This potential level is not expected to change significantly, and new demand opportunities appear minimal. Examination of the potential for future imports from the USA indicates that availability will tighten over the medium term, necessitating a search for new corrugated waste supply sources. Possible sources include supermakets, retail chains and large assembly manufacturing establishments; one of the most promising of these sources is shopping malls, and a study is appended which examines the feasibility of a corrugated waste source separation program within a hypothetical mall. Possible government actions are outlined to improve reclamation and recycling of corrugated waste in Canada, including the improvement of local recovery capabilities in British Columbia, Ontario and Quebec, and the reduction of freight costs for moving corrugated waste from low-recovery areas to high-demand areas. 26 refs., 9 figs., 31 tabs.

15020 **(MA—7811) Waste paper recycling opporunities for government action. Vol. 3. Fine paper waste. Final report.** Beiley, J.; Love, P. (Middleton Associates, Toronto, Ontario (Canada)). 1978. 153p. (CE—02206). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study analyzes current and expected market conditions for fine waste paper in Canada, with the objective of identifying government initiatives which could permanently increase recovery levels. Emphasis is placed on defining short term, practical measures. Fine paper waste is especially suitable for recovery because it has a high resale value and it is the principal type of paper generated by government offices, thus is subject to direct influence and action in the recycling process. The kinds of fine paper and the sources of fine paper waste are outlined, and data are presented on the generation, demand, and recovery of such waste in the major Canadian regions. The future potential for increased reclamation and recycling is projected under base-case and other scenarios. These projections also take into account new demand possibilities such as the use of deinked paper. Government actions are suggested to improve reclamation and recycling of fine paper waste, including promoting paper recovery in office buildings, establishing a contaminant control program, modifying transport costs for these wastes, and promoting new uses for fine wastes. 42 refs., 12 figs., 39 tabs.

15021 **(MA—7811) Waste paper recycling opportunities for government action. Vol. 2. Waste newsprint. Final report.** Bailey, J.; Love, P. (Middleton Associates, Toronto, Ontario (Canada)). 1978. 269p. (CE—02205). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study analyzes current and expected waste newsprint market conditions in Canada with the objective of identifying government initiatives which could permanently increase recovery levels. Data are presented on national and regional waste newsprint demand, generation and recovery, with 1976 used as a base year. An increase in cellulosic insulation production has resulted in a significant increase in waste newsprint demand in Canada, with insulation production taking a significantly larger share of total consumption. A possible new demand may arise in the future due to exports of waste newsprint to Asian countries. On the supply side, over 2/3 of waste newsprint generated in 1976 was old newspapers, and over 2/3 of this quantity was produced in Ontario and Quebec. The increase in domestic demand has led to development of a wide range of new recovery efforts, and demand in 1977 was large enough to have necessitated recovery of 40% of waste newsprint generated in major urban areas if no imports had been available. Projections are made regarding the future demand, generation and recovery of waste newsprint under base-case and other scenarios that include such parameters as the degree of market penetration of cellulose insulation. New uses for waste newsprint, which could increase demand, are examined, including shredded newsprint as animal bedding, waste news in the incineration of sewage sludge, spray-on cellulosic insulation, and inked or deinked waste newsprint for newsprint production. The regional supply and demand imbalances likely to exist in the future are outlined, and government actions are recommended to improve reclamation and recycling levels. 85 refs., 36 figs., 66 tabs.

15022 **(MA—7811) Waste paper recycling opportunities for government action. Vol. 1 summary. Final report.** Bailey, J.; Love, P. (Middleton Associates, Toronto, Ontario (Canada)). 1978. 28p. (CE—02204). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper presents a summary of analyses of the current and expected waste paper market conditions in Canada with the objective of identifying government initiatives which could permanently increase recovery levels. Emphasis has been placed upon defining short-term, practical measures which take into account the variations in market conditions for each of the major types of secondary fiber: newsprint, fine paper, and corrugated cardboard. Demand, generation and recovery are analyzed for each of these types on a national and regional basis. The opportunities for increased recycling in each region are identified and recommendations are made regarding appropriate government actions. The principal benefits of increased waste paper reclamation and recycling are perceived as: reducing waste management costs, creating new industries, promoting the conserver ethic, conserving forest and energy resources, and reducing pollution. Includes glossary. 1 fig., 5 tabs.

15023 **(NEI-FI—63) Improvement of the energy economy of the industrial building using modern control systems.** Yrjoelae, J.; Heikkinen, L. (Projekti-Insinoeoerit Oy, Vantaa (Finland)). Nov 1988. 85p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756280/JAW.

The purpose of this study was to determine the potential for saving energy in small to mid-sized industries through the operation of the facilities HVAC control system. The results of this study are based on on-site measurements. Beyond the scope of this report are process industries where a very small fraction of the energy required for heating is used by the HVAC facility. The potential savings possible with HVAC control system improvements is a very strong function of the type of industry considered. The machine assembly industry, for instance, offers the greatest potential savings. The wood-manufacturing and food industries also offer impressive savings. It is estimated that the total national energy savings possible through control system improvements amounts to 88 TWh/year or 63 million marks/year. The report considered six ways of improving the HVAC control system. They are: application of a demand-controlled HVAC system, waste heat utilization control, control system upgrading integration of process and HVAC control systems, gasburning radiative heater control, and DDC control. The actual industries that were involved in the study included: a printer, a couple of machine assembly facilities, a rubber manufacturer, a pharmacutical manufacturer, a food preparation facility, and a producer of prefabricated concrete products. With the aid of these measurements and calculations, it is possible to save significant amounts of energy with a very small investment. The greatest saving occured when the HVAC control system was set up to eliminate waste by using a demand-controlled philosophy. It was discovered that there were sometimes significant flaws in the HVAC system and control system. Mostly these were the result of inadequate maintenance or careless installation.

15024 **(NP—9770237) Tests for shedding the load of electric consumption in tile firing by use of a roller passage kiln. Final report.** Bremer, W. (Agrob Wessel Servais A.G., Bonn (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). [1988]. 12p. (In German). NTIS (US Sales Only), PC A03. Order Number DE89770237/JAW.

For the on-glaze firing of ceramic products - especially earthenware and stoneware tiles, roller passage kilns are being installed and used increasingly in the past years to achieve a clear shedding in the load of electric consumption compared to the traditional procedure in the tunnel kiln with ceramic kiln furnitures. The aim of this project - to adapt a roller passage kiln to once firing was interrupted to begin with according to the working scheme point 2.1.1 and 2.2.1 and later discontinued in accordance with the project management energy research of the KFA, Juelich because of the more important duties to consolidate the companies AWS AG and AGROB AG. The final reports is therefore restricted to the points according to the working scheme Establishment of the fundamentals; Firing tests; Once firing of earthenware wall tiles; Brick tiles; Development of appropriate carrying equipment; Bars; and Bar frames.

15025 **(ORF/ES—NRCC26194) A review of the Heat Pump Research and Development Program.** (Ontario Research Foundation, Mississauga (Canada). Engineering Sciences Div.). 1986. 114p. (CE—02183). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document provides an overview of a Canadian program to investigate and develop heat pumps. The program started in 1976 with the objectives of assessing the feasibility of using heat pumps to provide part or all of the heating requirements in residential buildings. Following the oil crisis in 1979, the program was expanded to include heat pump applications in industry. To demonstrate the heat pump's energy conservation potential, demonstration projects were implemented in the areas of industrial applications, residential applications, and system and component development. The program was terminated in late 1984, but measures have been taken to maintain the research activity and complete some of the projects of future technological and economic value. This document also presents an outline of commercial and experimental heat pump technology. Summaries are made of 24 industrial and 24 residential applications studies, demonstration projects, and research projects. Under each project, the objectives, system design, operating experience, performance, and economics are described. 50 refs., 60 figs., 16 tabs.

15026 **(PB—89-127401/XAB) Seminar on black liquor combustion held in Lappeenranta, Finland on February 24-25, 1988.** Huovilainen, R.T.; Meuronen, V. (Lappeenrannan Teknillinen Korkeakoulu (Finland)). 1988. 191p. NTIS, PC E07/MF A01.

Contents include: principles of black liquor combustion; properties of black liquor; combustion properties of black liquor; comparison of firing methods; furnace gas flow and mixing; modeling of combustion in a recovery boiler; soda recovery boiler materials; control of soda recovery boilers; construction of soda recovery boilers; formation and reduction of emissions.

15027 **(SA—7802) The utilization of metallic scrap generated by federal facilities in the Atlantic region.** (Shnay (Robert) and Associates Ltd., Montreal, Quebec (Canada)). [1988]. Vp. (CE—02203). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this study was to determine the amount of metallic waste or scrap generated at Canadian federal facilities in the Atlantic region, the degree of recycling of this material, and the steps (if any) that should be taken to improve reclamation and recycling of this material. The total amount of ferrous scrap generated by these facilities, including Crown corporations, is ca 200,000-250,000 tons/y; nonferrous scrap amounts to 40,000-50,000 tons/y. As far as can be determined, very little of this nonferrous material goes to dumps or is otherwise wasted. The Atlantic scrap industry is relatively underdeveloped, and is declining due to lack of local markets and the generally wide dispersion of material. The scrap generated at federal facilities is sold through the Crown Assets Disposal Corporation, whose activity is more involved with disposal than with marketing. The Corporation's scrap classifications bear little relationship to those used in industry, and little effort is made to present a marketable commodity. Recommendations are made to improve the Corporation's scrap operations in order to increase their reclamation of recyclable materials and to bring in more revenues. A review of the major Federal scrap generators shows that their gathering, collection, sorting and recycling activities are generally well executed and the amount of scrap ending up as waste is minimal. No economic justification was found for any major changes nor for any investment in equipment. Broad policy recommendations are made for assistance to the scrap industry in order to bring major improvements in recycling to the whole society. 1 tab.

15028 **(SA—7903) Management of metallic scrap resources.** (Shnay (Robert) and Associates Ltd., Montreal, Quebec (Canada)). 1979. 18p. (CE—02217). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document provides a guide to management procedures which will ensure maximum recycling of the metallic scrap generated in public and industrial establishments. Such procedures start at the scrap generation point, with sorting of various materials, and removal of non-metallic materials, being done as close to the generating point as possible. Guidelines are presented for the scrap manager which emphasize the duty to produce the maximum value for the scrap at minimum cost. Preliminary steps are outlined for carrying out a scrap survey, selecting suitable scrap receiving and storing areas and facilities, and ensuring awareness of the benefits of scrap management among all appropriate personnel. More detailed procedures are given for scrap management at the generating point, the receiving area, and the storage area; emphasis is placed on the use of proper sorting as a way of increasing the value of the scrap collected. Special attention is paid to scrap management at machine shops, maintenance departments and metalworking installations, as

these sites generate a relatively large amount of high quality scrap. A section on marketing of scrap is presented, noting that there are certain minimum lot sizes that enable easier selling of scrap. Suggestions are made for practical scrap management systems according to the amount of scrap generated per year, the larger establishments having higher requirements for scrap sorting and segregation.

15029 **(SLU-LBT—59) Air and heat balances in animal houses.** Gustafsson, G. (Swedish Univ. of Agricultural Sciences, Lund. Dept. of Farm Buildings). 1988. 393p. (In Swedish). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88756293/JAW.

The purpose of the present thesis was to analyze the biological requirements of climate of different species of animals, but also to investigate how different environmental factors and climate control technique affect the thermal climate and the levels of air contamination in animal houses. The thermal requirements of cattle and pigs were analyzed with thermodynamic models. It was found that air temperature requirements of animals differ widely depending on the species of animals, body weight, food intake, air velocities, radiation and insulation of the floors. Climate control techniques should therefore be designed with consideration to all these factors. (17 p english summary)

15030 **(SPAR—7904) A Canadian recycling newsletter. Final phase.** (S.P.A.R. Systems, Ottawa, Ontario (Canada)). 1979. 116p. (CE—02225). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study was performed to publish a Canadian recycling newsletter, to be distributed gradually throughout the country. This report reviews the format, data collection procedures, printing, mailing, advertising, marketing, promotion, and finances of the publication. In the final phase of the study, publication and distribution was to extend to various segments of the secondary materials industry. This would include publishing articles and industry briefs related to the ferrous and non-ferrous metals industry. The publication would be increased to 12 pages and would attempt to become financially self-sufficient. In this phase, the newsletter became firmly established as the voice of Canada's secondary materials market, especially waste paper, where the price guide published by the newsletter became a sort of recognized standard. It was found that financially independent operation was achieved within one year. The newsletter was published on schedule and reader response was positive. Examples of the newsletter, called Recoup, are included in the appendix.

15031 **(SRA—7901) The utilization of ferrous scrap in Canada.** Shnay, R.C. (Shnay (Robert) and Associates Ltd., Montreal, Quebec (Canada)). 1979. 105p. (CE—02221). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The consumption and supply of ferrous scrap in Canada are reviewed in this report in order to determine changes in trends or patterns since 1972. Overall supplies have increased, and there have been major regional changes over the past five years. Most of these changes have been a result of the rationalization of the scrap industry, as well as the increased participation by governments and consumers. Scrap trade with the USA, previously characterized by scrap imports into Canada to satisfy increases in demand, has changed since the imposition of scrap export controls in the USA; imports from the USA have stabilized and exports have grown. Federal and provincial government programs have been instituted to study scrap supplies and to recycle ferrous scrap, notably derelict motor vehicles. Regional imbalances in scrap supply and demand are noted, with the Atlantic provinces, Ontario and British Columbia having a supply surplus at the present time. This pattern is projected to change, and overall Canadian demand for scrap is expected to exceed supply in 1983 by 742,000 tons, as long as current scrap utilization efficiency remains the same. Changes in consumer technology, developments in the auto industry, and the increasing use of coated and alloy steels will all have major effects on the supply, demand, and quality of ferrous scrap. For example, changes in automobile design to reduce corrosion and improve fuel efficiency are reducing the amount of scrap generated and also the need for scrap. Recommendations are made for increasing utilization of Canadian scrap. 9 figs., 18 tabs.

15032 **(VTT-TUTK—550) Development of present drying methods of veneers.** Soeyrilae, P.; Siimes, H.; Salin, J.-G. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Puulaboratorio). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1988. 50p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756316/JAW.

Methods improving the present veneer drier's energy economy are studied. The theories of the methods are presented and their influence on energy costs and drying capacity are studied mainly by simulating different methods for control of drying gas. The matters studied are the influence of the drying gas velocity, segmentation of the drier into separate departments, use of concurrent and counter current principle in control of drying gas and pre-heating of veneer with the exhaust gases of the drier. The possibilities of using heat pumps in veneer drier are also examined and the costs of heat losses through the drier shells are determined. The optimum impinging jet velocity of drying gas is about 20 m/s. With decreasing velocity the drying capacity decreases faster than the energy costs and with increasing velocity the energy costs increase faster than drying capacity increases. Similar results were obtained in laboratory drying tests. Owing to the arrangement of intake of make-up air and exhaust of drying gases the head of the present deck driers operates on concurrent principle and the end on counter current principle. By using pure counter current the energy consumption can be reduced by about one percent compared with pure concurrent. The capacity is almost independent of the direction of the current. The exhaust air of the drier can with various arrangements be used for pre-heating of veneers. In the most advantageous case, energy consumption decreases by about 8% and capacity increases by almost 10%. As the decrease in the yield of the heat recovery plant is at least as large as the energy saved, the pre-heater investment should be compared with normal drier extension of the same length, which gives a 20% increase in capacity without saving energy.

15033 **Systematic testing of ceramic rolling bearing elements.** Wedeven, L.D.; Pallini, R.A.; Hingley, C.G. pp 58-73 of Selection and use of wear tests for ceramics; Proceedings of the Symposium on Selection and Use of Wear Test Systems for Ceramics, Cincinnati, OH, May 13, 1987. Yust, C.S.; Bayer, R.G. Philadelphia, PA; American Society for Testing and Materials (1988). (CONF-8705359—).

From Selection and use of wear tests for ceramics; Cincinnati, OH, USA (13 May 1987).

Several levels of ceramic test devices are recommended for the tribological evaluation of ceramic materials for high thermally and mechanically stressed rolling element bearings. A high temperature traction rig, four-ball rig, and full-scale bearing rig provide a systematic series of tests that are used as part of the design and development process for ceramic bearings. Operation of the traction rig from pure rolling to incipient sliding and gross slip allows evaluation of ceramic materials under controlled conditions of normal and tangential shear stress. 6 references.

15034 **Anaerobic treatment of industrial wastewaters.** Torpy, M.F. Park Ridge, NJ; Noyes Publications (1988). 122p. Noyes Publications, Mill Road at Grand Ave., Park Ridge, NJ 07656.

The latest advances in anaerobic treatment of industrial wastewaters are described in this book. The technology of anaerobic digestion has developed significantly in recent years. It has gained increased credibility from successful applications in industry as well as other sectors. Anaerobic biological waste treatment offers advantages over aerobic systems in terms of lower energy requirements, less biological sludge production, and the potential for energy recovery in the form of methane gas. The development of innovative reactor designs, based on the optimization of growth and retention of aerobic microorganisms, has created an impetus to reevaluate the anaerobic treatability of many industrial waste streams. The most recent and significant advances in anaerobic digestion are related to the technology's ability to accommodate rela-

tively high rates of organic loading. Companies are also interested in using anaerobic digestion for the biodestruction of organic materials that are not removed in conventional aerobic treatment.

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REFER ALSO TO CITATION(S) 14231, 14489, 14492, 14496, 14694, 14835, 14852, 14870, 14872, 14905, 14922, 15018, 15019, 15021, 15022, 15030, 15951

15035 **(CONF-890342—1) Some simple economics of improved cookstove programs in developing countries.** Jones, D.W. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002979/JAW.

From Association of American Geographerss meeting; Baltimore, MD, USA (19 Mar 1989).

More efficient cookstoves have been introduced in developing countries by development agencies to retard deforestation and to improve the welfare of low-income consumers. To date, studies of the economics of cookstove programs have been limited to financial analyses of stove costs and an input-output study of a single country. This paper examines the consequences of the implicit income effect of a 25% to 50% improvement in fuel efficiency of household cookstoves. A model is constructed to examine the spending pattern of resources saved from reduced fuel expenditures and the consequences of fuel price reductions caused by reductions in aggregate demand. It is found that, with parameter values typical of low-income developing countries, roughly 50% of technical fuel savings from stove efficiency improvements are lost through increased fuel use induced by income and price effects. Even when the income elasticity of demand for the fuel is zero, an own-price elasticity of one-half, with a unitary supply elasticity, 28% of the initial technical savings will be lost through increased consumption. 22 refs., 6 tabs.

15036 **(CONF-8806229—1) Screening and degradation tests of friction-reducing dilute polymer solutions for DHC applications.** Choi, U.S.; Kasza, K.E.; Liu, K.V. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003982/JAW.

From 79. IDHCA conference; Chautauqua, NY, USA (26 Jun 1988).

In order to identify friction-reducing additives that have a reasonable lifetime at DHC temperatures, screening and degradation tests of two high-molecular-weight linear-polymer additives and three fibers have been performed. An important discovery in this study is that with flow shear similar to that encountered in practical DHC pipe flow Separan is highly effective and have a reasonable lifetime at DC temperatures. Also, synthetic fiber is a promising additive capable of reducing frictional pressure drop at district heating and cooling temperatures. Testing in a large scale DHC system simulator will be conducted to study the effect of high flow shear in a centrifugal pump on the degradation of promising additives. 8 refs., 8 figs.

15037 **(DOE/CE/26555—T1) Feasibility of district heating and cooling for Springfield, Oregon.** (Brown and Caldwell, Eugene, OR (USA)). Sep 1987. Contract FG01-86CE26555. 241p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006448/JAW.

Springfield has three industrial plants, each with sufficient waste heat to provide heating for most of the city's commercial and institutional buildings. This fact, along with a high degree of energy awareness, made Springfield an obvious candidate for an investigation of district heating. This report investigates the possibility of developing a district heating and cooling system that uses industrial waste heat to provide space heating and water heating for a group of customers, or subscribers. The main component of a district heating system is a central plant that converts an energy source, in this case industrial waste heat, to energy that can be used in buildings. The next component is a distribution piping system that transports the heat, in this case hot water, to the subscribers. The final component of the district heating system is the connection to the building. This includes the piping and a meter to determine the energy use at the building. The potential benefits of district heating were examined, as were institutional considerations. Once financing considerations and ownership options were evaluated, the final evaluation of alternatives was made. The conclusion presented explains that none of the alternatives are economically feasible at this time; however, all are technically feasible and may become economically feasible in the not-too-distant future. 11 figs., 11 tabs.

15038 **(DOE/CE/64613—T1) Small Institutions Energy Program Assistance (SIEPA): Developmental state program for institutional conservation: Final report.** (New York Energy Office, Albany (USA)). Dec 1988. Contract FG01-86CE64613. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006449/JAW.

The principal goal of this Small Institutions Energy Program Assistance was to develop and implement a program to initiate, promote and assist in implementing energy conservation in the following types of small institutions: K-12 public and private schools, municipalities, and non-profit public care institutions. This energy conservation program was designed to address the problem of small facilities that traditionally have had little success in carrying out energy efficiency projects because of one or more of the following conditions: limited management capability, difficulty in securing financing and lack of technical expertise and awareness regarding how to achieve energy savings. The vehicles for advancing this program were statewide or regional organizations representing the small institutions that perceived a need to provide energy conservation services to their affiliated institutions or facilities. The objectives of this program were to enhance the abilities of small institutions to implement energy conservation measures in their facilities, reduce long term and short term energy costs in those facilities, and establish an ongoing, self-sufficient energy conservation capability for small facilities within regional and statewide umbrella organizations representing these small institutions.

15039 **(DOE/CE/64613—T1-App.-Vol.1) Small Institutions Energy Program Assistance (SIEPA): Appendices: Volume 1, A--F: Final report.** (New York Energy Office, Albany (USA)). Dec 1988. Contract FG01-86CE64613. 39p. NTIS, PC A06 - OSTI. Order Number DE89006450/JAW.

The principal goal of this Small Institutions Energy Program Assistance was to develop and implement a program to initiate, promote and assist in implementing energy conservation in the following types of small institutions: K-12 public and private schools, municipalities, and non-profit public care institutions. This energy conservation program was designed to address the problem of small facilities that traditionally have had little success in carrying out energy efficiency projects because of one or more of the following conditions: limited management capability, difficulty in securing financing and lack of technical expertise and awareness regarding how to achieve energy savings. The vehicles for advancing this program were statewide or regional organizations representing the small institutions that perceived a need to provide energy conservation services to their affiliated institutions or facilities. The objectives of this program were to enhance the abilities of small institutions to implement energy conservation measures in their facilities, reduce long term and short term energy costs in those facilities, and establish an ongoing, self-sufficient energy conservation capability for small facilities within regional and statewide umbrella organizations representing these small institutions.

15040 **(DOE/CE/64613—T1-App.-Vol.2) Small Institutions Energy Program Assistance (SIEPA): Appendices: Volume 2, G--H: Final report.** (New York Energy Office, Albany (USA)). Dec 1988. Contract FG01-86CE64613. 175p. NTIS, PC A09 - OSTI. Order Number DE89006451/JAW.

The principal goal of this Small Institutions Energy Program Assistance was to develop and implement a program to initiate, promote and assist in implementing energy conservation in the following types of small institutions: K-12 public and private schools, municipalities, and non-profit public care institutions. This energy conservation program was designed to address the problem of small facilities that traditionally have had little success in carrying out energy efficiency projects because of one or more of the following conditions: limited management capability, difficulty in securing fi-

nancing and lack of technical expertise and awareness regarding how to achieve energy savings. The vehicles for advancing this program were statewide or regional organizations representing the small institutions that perceived a need to provide energy conservation services to their affiliated institutions or facilities. The objectives of this program were to enhance the abilities of small institutions to implement energy conservation measures in their facilities, reduce long term and short term energy costs in those facilities, and establish an ongoing, self-sufficient energy conservation capability for small facilities within regional and statewide umbrella organizations representing these small institutions.

15041 **(DOE/CE/64615—T1) Developmental state programs for institutional conservation programs: Final technical report, 1 October 1986--30 September 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 111p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006974/JAW.

In 1986, the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) proposed to the US Department of Energy (DOE) to develop and implement an innovative program to increase energy efficiency in the institutional building sector. EMNRD submitted this proposal to DOE in response to DOE Solicitation No. DE-PS01-86CE64606, "Developmental State Programs for Institutional Conservation." The proposal provided for a variety of energy efficiency services to be provided to small, rural public school districts in New Mexico. This group of institutions historically had one of the lowest participation rates in energy conservation programs in New Mexico. Typically, these institutions had limited resources available to become involved in such activities. This report describes the activities that were conducted under DOE Grant No. DE-FG01-86CE64615 by EMNRD. This report consists of five volumes and a separate executive summary: the first volume describes the project; the second, third and fourth volumes contain copies of energy evaluations that were conducted for all participating public school districts; and the fifth volume contains copies of other materials that were developed under the project.

15042 **(DOE/CE/64869—T1) Community-sponsored financing programs for hospital energy investments: Final report.** (American Hospital Association, Chicago, IL). Feb 1989. Contract FG01-86CE64869. 33p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006841/JAW.

It was the purpose of this initiative to combine the resources and expertise of national and local organizations in a concerted effort to develop and demonstrate model community-based financing programs designed to increase hospital access to private sector capital for energy saving investments. The joint national-local initiative focused on providing two demonstration-site communities with expertise, technical assistance, and seed development funds to aid in achieving the following objectives: accumulating data to determine the level of investment opportunities and to build confidence in the financing process; identify and verify the actual cost savings as a result of the project; identifying and gaining access to moderate-cost capital sources; securing permanent local support for the community-sponsored energy financing program; and publish the result of the energy-saving project and financing model for health care industry.

15043 **(EPPRG—1980) Renfrew County energy conservation project - a community energy study, January 28 - March 31, 1980.** (Energy Pathways Policy Research Group, Killaloe, Ontario (Canada)). 1980. 183p. (CE—02251). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Energy use and conservation potentials are analyzed for a rural county in Ontario. Detailed examination is made of how energy in the county is supplied or produced, and used, according to energy source and type of end-use. The county is characterized by sparse population in a large area, low income, and economic dependence on primary resource development, notably forest industries. Energy expenses in the county show a dependence on energy sources from outside the county, with consequent adverse effects on the local economy. The largest single energy source is heating oil, which supplied 34.6% of the county's energy in 1979, and which was mainly used for home heating. However, oil is showing a marked decrease as a home heating fuel due to market conditions, and surveys conducted in this study show that many households using oil also use wood or electricity as a supplementary heat source. A major part of this report considers wood as an alternative energy source for the county. Examination of the county's wood resources indicates substantial reserves are available, supply is secure, and wood energy costs are competitive. Wood wastes form a substantial untapped resource and offer the potential of large energy yield without additional stress on the forest resource, especially if used as an energy source in the forest industry itself. The report also presents results of a survey of residential energy use, examining such items as type of home heating, transportation energy use, and attitudes on the effect of energy costs. Suggestions are made to provide long-term solutions to the county's energy problems, stressing conservation and renewable resources. 81 refs., 37 figs., 42 tabs.

15044 **(EPS—EPSI-EC-78-2) Guide for the recovery of high grade waste paper from federal office buildings through at-source separation.** (Environment Canada, Ottawa, Ontario. Environmental Protection Service). 1978. 47p. (CE—02229). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This guide is intended to serve as a manual for organizing and managing office waste paper recovery programs in Canadian federal buildings. Waste paper generated in such buildings is of particular interest for recycling as it is produced in sufficiently large amounts, and contains large amounts of high-grade waste paper which obtain good prices from paper mills. The key to successful recovery of such paper is separation, at the source of waste generation, from other less-valuable papers and non-paper materials. In recommending ways to do this, the manual covers assessment of the viability of a collection program in a particular building, estimating the quantities of waste generated, calculating storage space necessary, marketing the paper collected, using proper collection and storage containers, promoting employee awareness, and administering and monitoring the program. A sample cost-benefit analysis is given for a general office building with 1,000 employees. Includes glossary. 14 refs., 10 figs., 5 tabs.

15045 **(EPS—SPEI-EC-78-2F) Guide for the recovery of high grade waste paper from federal office buildings through at-source separation.** (Environment Canada, Ottawa, Ontario. Environmental Protection Service). 1978. 38p. (In French). (CE—02230). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This guide is intended to serve as a manual for organizing and managing office waste paper recovery programs in Canadian federal buildings. Waste paper generated in such buildings is of particular interest for recycling as it is produced in sufficiently large amounts, and contains large amounts of high-grade waste paper which obtain good prices from paper mills. The key to successful recovery of such paper is separation, at the source of waste generation, from other less-valuable papers and non-paper materials. In recommending ways to do this, the manual covers assessment of the viability of a collection program in a particular building, estimating the quantities of waste generated, calculating storage space necessary, marketing the paper collected, using proper collection and storage containers, promoting employee awareness, and administering and monitoring the program. A sample cost-benefit analysis is given for a general office building with 1,000 employees. Includes glossary. 14 refs., 10 figs., 5 tabs.

15046 **(MA—EPS3-EC-78-3) Supplement to the guide for the recovery of high grade waste paper from federal office buildings through at-source separation.** (Middleton Associates, Toronto, Ontario (Canada); Boston, Gilbert, Henry Associates Ltd. (Canada)). 1978. 59p. (MICROLOG—80-0219; CE—02228). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report contains background information for an earlier report on waste paper recycling in Canadian federal office buildings. It reviews a number of recycling programs in Canada and the USA and uses the results to estimate the quantity of different grades of paper recoverable from a general administrative office building. A method is then given for sampling, evaluating and calculating recoverable waste in such a building. Four collection procedures are reviewed: desktop containers, dual wastebaskets, central containers, and desktop plus central container. Analysis is performed on the economics of programs which separate waste paper at source, and the minimum conditions that will usually ensure the economic viability of these programs are described. The report also examines the market for waste paper in Canada and presents lists of Canadian paper mills that accept recycled paper, and Canadian paper recycling companies. Factors that may affect the viability of waste paper recycling programs in office buildings are discussed. These include the use of xerographic copy paper, which presents de-inking and contamination problems when recycled. 14 refs., 3 figs. 7 tabs.

15047 **(NEI-FI—68) Factors affecting the possibilities to reduce the temperature level of district heating networks.** Maekelae, T. (Laempoelaitosyhdistys Ry, Helsinki (Finland)). 1987. 27p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756284/JAW.

The report describes the factors affecting the possibilities to reduce the temperature level of district heating networks. The effects of the temperature level to the correlation between supply and return temperatures, het losses, pumping costs, combined heat and power production, thermal stresses, properties of the insulation, accuracy of regulating and measuring, new energy sources and heat storages have been described. Also the limiting factors, such as the consumer installations, dimensioning of the district heating network and energy demand of special consumers have been discussed. The possibilities and profitableness of reducing the temperature level vary a lot between different district heating utilities. The profitableness is especially affected by the heat production system and the necessary investments and other arrangements. The temperature level has an effect to the heat production costs for example where heat is produced in a combined heat and power plant. The use of low temperature heat sources, which will probably become more common in the future, implies also low network temperatures. It is difficult to estimate the necessary investments and other arrangements needed for lowering the temperature level in existing networks. Therefore experimental actions should be made in order to get more information.

15048 **(PB—89-129076/XAB) Wood-degrading fungi as degraders of hazardous waste.** Glaser, J.A. (Environmental Protection Agency, Cincinnati, OH (USA). Risk Reduction Engineering Lab.). Nov 1988. 9p. (EPA—600/D-88/258). NTIS, PC A02/MF A01.

The biological detoxification of hazardous waste is largely an underdeveloped technology. Bacterial species are known to possess a variety of detoxification skills, apparently associated with the need to survive. Single bacterial species may not have the ability to convert a toxicant to carbon dioxide and water. With the use of bacterial communities, there is the feature that each species of the consortium plays a role in the overall degradation of the waste with the inadequacies of one covered by the abilities of another. The stability of such consortia is of some concern since there may be environmental effects that permit the selection of certain members over others resulting in the loss or slowing of the degradation process. The use of fungi to degrade waste materials has not been investigated to any extent until recently. From the perspective of sewage treatment, filamentous fungi were to be avoided due to processing problems and in some cases fungi found in sewage can be pathogenic.

15049 **(TU/CEA—7903) Recycling of rubber tires in asphalt paving materials.** Piggott, M.R.; Woodhams, R.T. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 1979. 59p. (CE—02226). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

It has been known that the addition of rubber to asphalt used in paving will produced markedly superior road surfaces. Partly because of cost and because of the nonconventional paving techniques necessary, rubber has been largely ignored as a practical paving additive except in special cases. However, the large accumulation of old tires existing today provides a ready source for suitable rubber. If ground into a fine powder, this rubber can be mixed in a conventional pug mill along with sand, stone and asphalt to produce a hot mix which can be aplied in the normal manner without any special techniques. The extra cost of such modification is only 1% of a typical paving contract, whereas the advantages include lower maintenance cost, more durable road surface, and elimination of unwanted waste tires. This report has been prepared to assist civic and other authorities in the development of improved road surfacing formulations through the reuse of old tires. It includes the results of paving trials in Toronto and laboratory evaluations. These tests show that the addition of powdered rubber to asphalt paving materials markedly improves the durability and crack resistance, particularly at low temperatures. Additives in the rubber impart good strength retention in the presence of moisture. The toughness increases with age due to a slow interaction of the rubber with the asphalt which is accompanied by an increase in viscosity. As a result, performance is also enhanced at high temperatures and helps to minimize pavement distortions due to hot weather and traffic. 16 refs., 18 figs., 2 tabs.

15050 **(VTT-TUTK—565) Remote control of district heating load.** Kekkonen, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Laboratorio). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1988. 82p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756318/JAW.

District heating consumption can be remote-controlled. A short time control response will be up to +/-25% of the average output level. No harmful effects have been recognised by consumers. District heating remote control has been in pilot use during 1987-1988 in three Finnish district heating systems. The different load control alternatives were based on building automation, ripple control and radio control techniques. The aims of the project were to analyze control responses both at plants and at consumers as well as to collect experiences on constructing and using of new systems. Due to relatively high investment costs the new system does not meet economic feasibility in the case of small difference between operation costs of alternative heat production methods.

15051 **(DOE/CE/64869—T1-App.A-Pt.1) Energy survey study and report of hospitals in Chicago: South Suburban Hospital: Final report.** (Consulting Consortium, Inc., Chicago, IL (USA)). Aug 1988. Contract FG01-86CE64869. 188p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006838/JAW.

This study is part of a three-phased demonstration project to reduce energy consumption in hospitals through practical life-cycle/cost-effective modifications and alteration. Funds for the demonstration project are provided by the American Hospital Association (AHA), the Department of Energy (DOE), and the Department of Health and Human Services (DHHS). A thorough study and evaluation of all building systems is made to identify opportunities for reduction in energy consumption and to determine the most cost effective approaches to energy conservation. The primary objective of the study is to investigate and analyze energy usage of the facility and to identify all life cycle, cost-effective changes required to effect a reduction in energy consumption. For the purpose of economic evaluation of the energy conservation projects identified, life-cycle cost and simple payback periods are used. Energy conservation measures with simple payback periods exceeding five years were dismissed from further detailed study.

15052 (DOE/CE/64869—T1-App.A-Vol.1) **Energy survey, study and report of hospitals in Michigan: Appendix A: Volume 1, Saint Mary's Hospital Grand Rapids, Michigan: Final report.** (Manyam and Associates, Inc., Lansing, MI (USA)). Aug 1988. Contract FG01-86CE64869. 410p. NTIS, PC A18/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006840/JAW.

This study is part of a three-phased demonstration project to reduce energy consumption in hospitals through practical life-cycle, cost-effective modifications and alterations. Funds for the demonstration project are provided by the American Hospital Association (AHA), the Department of Energy (DOE), and the Department of Health and Human Services (DHHS). Two hospitals in Michigan were selected for the project, Bay Medical Center in Bay City and St. Mary's Hospital in Ground Rapids. The objectives of this study, which is funded by HHS, are to investigate and analyze energy usage of the facilities and to identify all life-cycle, cost-effective changes required to effect a reduction in energy consumption.

15053 (DOE/CE/64869—T1-App.A-Vol.2) **Energy survey, study and report of hospitals in Michigan: Appendix A: Volume 2, Bay Medical Center, Bay City, Michigan: Final report.** (Manyam and Associates, Inc., Lansing, MI (USA)). Aug 1988. Contract FG01-86CE64869. 299p. NTIS, PC A14 - OSTI. Order Number DE89006839/JAW.

This study is part of a three-phased demonstration project to reduce energy consumption in hospitals through practical life-cycle, cost-effective modifications and alterations. Funds for the demonstration project are provided by the American Hospital Association (AHA), the Department of Energy (DOE), and the Department of Health and Human Services (DHHS). Two hospitals in Michigan were selected for the project, Bay Medical Center in Bay City and St. Mary's Hospital in Grand Rapids. The objectives of this study, which is funded by HHS, are to investigate and analyze energy usage of the facilities and to identify all life-cycle, cost-effective changes required to effect a reduction in energy consumption.

15054 **Guidelines for successful solid waste management.** Walter, D.K. (Biofuels and Municipal Waste Technology Div., Office of Renewable Technologies, US Dept. of Energy (US));. pp v of Proceedings of the conference energy from solid waste: An option for local government. Lexington, KY; Kentucky Energy Cabinet (1987). (CONF-870536—).

From Energy from solid waste: an option for local government; Louisville, KY, USA (13 May 1987).

Why is the Department of Energy interested in waste-to-energy? Because all potential sources of energy involve national energy policy, a policy which calls for a safe, secure and affordable energy supply. It is absolutely true that municipal waste is a secure source of energy. Right now there is a barge that has been running up and down the east coast and around the Atlantic Ocean. Nobody wants the garbage that is on the barge. Well, if nobody wants the source of energy, then it is obvious it is a secure source. Additionally, the Department of Energy is trying to promote the productive use of something that is presumed to be a waste but is, in reality, a resource. The author presents the Department of Energy's perspective on solid waste management and waste-to-energy in the form of ten commandments.

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REFER ALSO TO CITATION(S) 14899, 14900, 14901, 14903, 14904, 14955, 14956, 14957, 14958, 14965

15055 **(CANMET—8003) Case history of the Saskatoon Energy Conservation Information Centre.** (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1980. 27p. (CE—02278). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The story of an energy conservation information center in Saskatoon is presented in this report. An examination of the characteristics of that city shows that there was a high energy awareness among the public and a number of local institutions interested in energy related matters. It was decided in 1978-79 that some sort of energy information center was needed by the public, and a pilot project was set up in a public library. The project ended, and it was decided to expand what the project had started by obtaining funding for a more permanent information center. A new site was found in a community college and opened to the public. Additional funding was sought and obtained in order to provide an energy extension service to the community. The center's effectiveness in information dissemination and its impact on public energy awareness is also evaluated.

15056 (EMR—9008, pp 18) **Promoting efficiency and conservation through consumption feedback and information.** Gaskell, G.; Ellis, P.; Pike, R. (London School of Economics, UK). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper reports the background theory and empirical results of a project on energy conservation in the domestic sector. The objective was to test the relative effects of three energy conservation strategies on a variety of indicators including levels of energy consumption, reported conservation behaviors, knowledge of domestic energy use and beliefs about energy issues. The three strategies were feedback on energy consumption, specific information on energy savings, and the two in combination. In a field experimental design, 160 households in London, England participated in the various conditions for an eight week period. The longer term effects on consumption were assessed twelve weeks after the experimental period. The combination of feedback and information was the most effective strategy in bringing about both long term reductions in consumption and increasing knowledge of domestic energy use. The prediction that energy conservation will occur only when consumers are aware of their ability to make savings, are motivated to do so, and know how to do so, was confirmed. The implications for energy conservation policy are discussed.

15057 (EMR—9008, pp 26) **The value of incentives in stimulating energy conservation.** McNeill, D.L.; Hutton, R.B. (Univ. of Denver, CO, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

In the fall of 1979, the US Department of Energy implemented in New England the Low Cost/NoCost Energy Conservation Program, which featured a number of inexpensive conservation measures for the home which could result in a 25% saving of the household fuel bill. A crucial aspect of the program was the use of an integrated marketing and communications effort designed both to inform and motivate the population. One part of this program was the personal delivery of an incentive package including a booklet explaining the conservation actions and a shower flow control device. This paper reports the effects of the program and discusses the contribution of the incentive package. A telephone survey of 1,207 New England households and of a control sample of upper New York State households was used to measure overall impact. Data were collected on demographics, attitudes towards the advertising of the program, and reported behavior by readers and non-readers of the energy conservation booklet. Overall differences between treatment and control conditions are examined in this paper with attention to the impact of the incentives. Differences between readers and non-readers of the booklet are discussed to determine the impact of the booklet itself. It was found that there was a significant behavioral change in New England on the program's conservation measures; the shower flow device incentive played a major role in the program effects. 71.1% of the New England sample reported reading the booklet and this readership was positively related to program effects. These effects were found for both the conservation behaviors and perceptions of the program ads. 12 refs., 8 tabs.

15058 (EMR—9008, pp 21) **Examining and influencing the energy conservation attitudes and behaviours of youth.** Kushler, M.G.; Jeppesen, J.C. (Michigan Dept. of Commerce, Lansing, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper discusses the results of a large-scale, multi-phase research effort which examined energy conservation attitudes and behaviors of high school youth and how they might be influenced. Data were collected from a survey of over 80,000 students in over 250 schools in nine states of the USA. Three separate phases of the research tested the possible methods for helping to create an energy conservation ethic in youth, investigated strategies designed to get teachers to teach about energy conservation in their classes, and surveyed attitudes and behaviors of youth in representative regions. Some important results are as follows. In terms of demographics, it appears that females are more positive toward conservation than males, and older students more positive than younger students. Positive response to energy conservation instruction was quite consistent across sex and grade level. Car owners were less positive toward conservation than non-owners, and owners of large cars were less positive than owners of small cars. The findings concerning energy conservation instruction are felt to have important public policy implications, as the data suggest that energy conservation instruction may be able to change significantly the attitudes and behaviors of high school students. 31 refs., 2 tabs.

15059 (EMR—9008, pp 11) **Tax credits as a means of influencing consumer behavior.** Pitts, R.E.; Wittenbach, J.L. (Univ. of Notre Dame, IN, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

The purpose of this paper is to examine the merits of tax credits as a means of stimulating energy conserving behavior in households in the USA, and to report the results of a study measuring the impact of the energy tax credit on the decision of consumers to insulate their homes. The study was conducted in a midwestern city and information was collected on participants' knowledge of the tax credit, the means of acquiring this information, the value of the credit, cost of the insulation, and demographic characteristics. The findings of this study indicate that the residential energy tax credit has had minimal effect on major insulation purchase decisions. Not one respondent considered the tax credit so important that the purchase would not have been made without its existence. Knowledge of the tax credit appeared very limited; despite the average $428 expenditure in the study population, only 61% of repondents had acquired any information about the credit prior to the final purchase decision. The purchase decision would appear to be such that the amount of consumer purchase is dictated by the need and ability to make the purchase. This study also supports the contention that tax credits do not benefit lower-income families as equally as higher-income families. 10 refs., 2 figs.

15060 (EMR—9008, pp 16) **Evaluation of a computerized home energy audit program in Minnesota.** Hirst, E.; Lazare, P. (Oak Ridge National Lab., TN, US; Dept. of Public Service, St. Paul, MN, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

In early 1979, Minnesota's largest power utility offered a computerized home energy audit called Project Conserve to all its 540,000 residential customers in structures with 1-3 dwelling units. The project consists of a 67-question form completed by the household; the answers are then processed by an engineering analysis computer model that computes potential energy savings, dollar savings, initial costs, and payback periods for several retrofit measures. A three-part evaluation of Project Conserve was conducted. Data collected and created for the 91,000 project participants were analyzed to determine the characteristics and energy conservation potentials of their homes. A main survey was then distributed to 2,200 households in the utility's service area, including questions on recent planned conservation actions and the reasons for these actions. Half the households who received questionnaires had participated in Project Conserve and the rest were randomly selected. Visits by trained student auditors were also used to gather information. The data presented in this paper indicate that Project Conserve participants cannot be easily categorized on the basis of the energy efficiency of their homes. As a group, participants represent neither the customers who stand to gain the most from an energy audit nor the most energy-conscious households. Instead, participants seem to be representative of all single-family homes in the utility's service area. 15 refs., 3 tabs.

15061 (EMR—9008, pp 17) **A multi-attribute analysis of consumer attitudes toward alternative space heating modes.** Berkowitz, M.K; Haines, G.H., Jr. (Univ. of Toronto, Ont.). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper presents four tests of the relationship between attitudes toward heating modes (oil, gas, electricity, and solar) based upon the characteristics embodied in each mode and preferences for the individual heating modes. Data were obtained from questionnaires sent to 2,109 households across Canada. Sixteen characteristics were presented to respondents and they were asked to evaluate the value importance of each attribute and, for each heating mode, to estimate the perceived instrumentality of each mode toward the achievement of each value importance goal for each product attribute. Respondents were also asked which characteristics were most important in their purchase decision. The results presented in this study tend to support the hypothesis that consumer preferences for heating modes can be disaggregated into their preferences for the bundles of characteristics which comprise each heating mode. While heating costs tend to be a significant variable in forming preferences for conventional modes, costs appear to be less relevant to the 21.5% of respondents preferring solar heating. For those respondents, system reliability, safety, absence of fumes and odors, and the future availability of the fuel supply are the primary factor which lead to their strong preferences for solar heating. 10 refs., 9 tabs.

15062 (EMR—9008, pp 15) **Energy conservation and adoption of household solar.** Markov, S. (Univ. of Connecticut, Storrs, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper examines certain relationships between residential energy conservation behavior and adoption of solar heaters as of May 1979 and November 1979, a 6-month period coinciding with a steep rise in the price of fuel oil. A sample of households in Connecticut seeking installation of solar hot water systems under an incentive program was studied to examine the factors involved in adopting a solar system. Data were collected on certain house characteristics, attitudes towards solar energy, energy conserving behaviors, responsiveness to financial incentives, and on information sources for energy conservation practices. It was found that household energy conservation behavior did not have any bearing on the propensity to acquire solar heating systems. The major perceived barriers to acquiring solar were economic or psycho-economic. A third of non-adopters judged that the same financial benefits could be achieved by home insulation and other conservation measures. These non-adopters were also likely to have abandoned all interest in solar after the 6-month period. Attribution of trust in various energy conservation information sources is unrelated to energy conservation behavior or solar adoption. Several policy and program implications of these results are discussed. 8 refs., 2 tabs.

15063 (EMR—9008, pp 21) **The role of interpersonal communication networks in the diffusion of energy conerving practices and technologies.** Leonard-Barton, D. (Massachusetts Inst. of Technology, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper presents findings from three studies about the adoption of energy conserving behaviors and solar heating systems in California. In an energy conservation study in Palo Alto, interviews with homeowners were used to obtain attitudes, self-reported behaviors, and energy usage. In the San Francisco area, homeowner interviews with solar equipment purchasers and nearby nonadopters were conducted to explore the barriers to solar adoption and the experience of solar owners with their equipment. In a statewide survey, interviews were conducted to determine the receptivity of homeowners to solar equipment, and to measure levels of awareness, interest, and intent to purchase. The paper then examines the role and importance of interpersonal communication networks in the diffusion of solar technology. It was generally found that the variables which are significantly related to the intention to purchase a solar system are also related to knowledge of solar equipment owners. These findings suggest that a credible source of information about residential solar equipment is a person who embodies safety credibility, rather than professional credibility, i.e., potential adopters appear to desire and seek information from solar owners who are like themselves. At present, active solar collectors to heat the home or water appear to have the greatest appeal for well-educated individuals of high income, and potential adopters are passing information around among themselves, but in a relatively closed network. Implications of these findings for solar marketers are discussed. 15 refs., 4 figs., 4 tabs.

15064 (EMR—9008, pp 21) **Exploring the consumer decision process in the adoption of solar energy systems.** LaBay, D.G.; Kinnear, T.C. (Univ. of New Hampshire, US; Univ. of Michigan, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

Research is presented on categorizing individuals who have adopted solar energy systems, and how such systems are evaluated. Empirical results are presented from research in Maine on a sample of consumers of residential solar heating and hot water heating systems, potential consumers who are aware of and knowledgeable about residential solar systems but who have not installed such systems, and potential consumers who are not knowlegeable about such systems. The hypotheses examined in the study related to demographics of adopters and non-adopters, their perceptions of solar energy systems, factors in the adoption of such systems, and whether attitudes or demographics are better at predicting adoptive behavior. Findings indicated that the adopters are younger, more highly educated, higher in income, earlier in the family life cycle, and higher in occupational status than the general population. Few differences are apparent between adopters and aware non-adopters. In their attitudes toward solar systems, adopters display more favorable attitudes than the general population or aware non-adopters. Product-related and economic factors are of the highest concern in the adoption decision, to both adopters and aware nonadopters. No differences in attitudes and characteristics among adopters were dependent on the time of adoption. Attitude perceptions are more effective than demographics in predicting an indivdual's being an adopter. Traditional adoption and diffusion-of-innovation models were found to be not entirely applicable when considering solar energy systems. 22 refs., 6 figs.

15065 (EMR—9008, pp 17) **Barriers to consumer choice of energy efficient products.** Claxton, J.D.; Anderson, C.D. (Univ. of British Columbia). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

The purpose of this paper is to relate energy labeling to consumer behavior research; to report on a major field experiment that assessed the impact on refrigerator sales of energy labels and sales staff energy information emphasis; and to discuss future labelling efforts in terms of major barriers that mitigate against consumer choice of energy efficient products. A number of national energy labeling programs are outlined; reviews of consumer research indicated that energy information at the point of sale appears to be an appropriate type of information program, that retail sales staff are a highly utilized and effective influence in appliance purchases, and that energy labeling may have some impact on purchase decisions. Pragmatic considerations are then given for investigating choices at the retail level relating to energy efficiency. The field experiment was done in Western Canada and involved simulated shopping tests, in which refrigerator energy labels and sales staff emphasis were manipulated and the effects on consumer behavior assessed. Findings showed that energy infomation treatments had no impact on the size of refrigerator purchased. For buyers of frost-free models, the probability of choosing an energy efficient refrigerator was somewhat increased when kWh consumption data were present. For buyers of 10 to 14 cubic foot models, the probability of choosing manual defrost was markedly higher when energy information was present. A slight increase in probability of noticing energy labels was observed in cases where the labels were emphasized by sales staff. Suggestions are made for future point-of-sale programs in light of the results of this study. 26 refs., 1 tab.

15066 (EMR—9008, pp 30) **An experimental investigation of consumer's decision to buy enegy efficient refrigerators.** Redinger, R.; Staelin, R. (Carnegie-Mallan Univ., Pittsburgh, PA, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

In an experimental study of the decision to buy energy efficient refrigerators, one objective was to test the validity of the payback model, which suggested that customers use a payback criterion whereby they would choose an energy efficient appliance, rather than a cheaper, less efficient model, if the increase in price was recouped in future operating cost savings within an acceptable time period. The study also attempted to estimate the effects of various market variables on the consumer's decision process and on his probability of purchasing an energy efficient appliance. The experiment consisted of a simulated shopping task and was conducted in a corporate appliance showroom using a sample of 123 people. The results indicated that the influence of salespersons dominated the consumer's choice of energy efficient models. Government-required energy labels, although insignificant, tended to have the unexpected effect of reducing the probability that consumers would buy energy efficient appliances. However, the labels did increase consumers' knowledge of operating costs. Energy advertisements did not affect the probability that consumers would buy energy directly, but they did increase the stated importance of energy in the decision. Although an investment decision model of payback predicted energy choice well at both the aggregate and individual levels, slightly less than half of the consumers in the study could be classified as making an investment-type decision. The majority seemed to treat energy efficiency as they would any other feature such as deluxe shelves or an icemaker. 3 refs., 20 tabs.

15067 (EMR—9008, pp 14) **Energy consumption in leisure and the quality of life.** Graef, R.; Gianinno, S.M.; Csikszentmihalyi, M. (Univ. of Chicago, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

To explore the relationship between high energy consumption in leisure activities and the quality of life, data have been gathered from surveys of everyday life experiences. Leisure activities were weighed by their average Btu consumption indices and by the

amount of time spent doing them. Two null hypotheses were examined: that leisure activities requiring greater energy consumption will not produce higher levels of satisfaction or happiness than those activities requiring lower consumption levels; and that people who use more energy overall in their leisure activities will not have a higher level of satisfaction or happiness with either their leisure activities or with their lives as a whole. Data were collected by the Experiential Sampling Method, which involved randomly signalling people during waking hours for a 7-day period. The signalling was accomplished via electronic paging devices and the data was recorded on standarized information sheets. Each time a participant was signalled, he or she would answer questions and respond to structured items about his or her immediate experience. The sample was composed of 107 working men and women between 19 and 63 years of age, and each participant responded to an average of 46 signals per week. Both of the null hypotheses were confirmed, and an interpretation of the findings is presented which suggests the inherent limitations and potentially negative consequences for individual well-being of energy-intensive leisure activities. 11 refs., 1 fig., 2 tabs.

15068 (EMR—9008, pp 15) **Consumer decision making and energy conservation in residences.** Levin, M.; Ruhm, C.; Corum, K.R.; McMahon, J.E.; Andrews, L.; O'Neal, D.L.; Brown, S.P.A.; Calloway, J.M.; Reid, F.A.; Sharma, K. (Lawrence Berkeley Lab.; Mathematical Sciences Northwest; Brookhaven National Lab.; Pacific Northwest Lab.; Oakridge National Lab.). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper provides an overview of the research under way to improve understanding of the factors influencing the decisions of consumers on the energy efficiency of new residential equipment. It also presents some preliminary conclusions which indicate that numerous factors lead to high discount rates among residential consumers of energy using and energy conserving equipment. As a result of this high discount rate, there is a substantial under-investment in energy conservation in this area. Specific research efforts outlined in this paper are investigating implicit discount rates for energy conservation in new residential buildings, implicit discount rates for energy efficiency in appliances and furnaces, segmentation of appliance sales and efficiency data by markets, implicit discount rates by market segment, and effect of implicit discount rates on residential energy demand forecasts. In a study of the life cycle cost method of calculating implicit discount rates, it was found that in most cases, the calculated rates are much higher than market interest rates, thus verifying the hypothesis that consumers fail to consider fully the benefits of energy savings when investing in energy-saving goods. In a sensitivity analysis of energy savings due to appliance standards, two important variables that had a large impact were the energy price escalation rates and the implicit discount rates. 9 refs., 2 tabs.

15069 (EMR—9008, pp 18) **An international perseptive on energy conservation.** Gradin, R. (International Energy Agency, Paris). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper presents an overview of energy conservation programs in the 21 member countries of the International Energy Agency (IEA). A wide array of financial and informational energy conservation initiatives has been implemented or proposed, but there are wide discrepancies in policy scope and comprehensiveness among countries. Most counries have achieved only a small part of their potential for conservation, indicating that strengthened policy actions are needed. This paper includes discussion of program types by sector and, where available, conservation results. Some of the most important conservation initiatives include: publicity campaigns about energy conservation; pricing measures to encourage conservation, such as energy taxes and appropriate rate structures; incentives to encourage investments leading to energy conservation; and establishment of energy efficiency standards. Conservation measures are found to be an effective method for dealing with energy problems, as they are economically attractive, consistent with environmental protection, do not consume finite resources, and achieve significant energy savings. 1 ref., 4 tabs.

15070 (EMR—9008, pp 17) **Energy conservation in the United States; federal programs versus individual community actions.** Cannon, L. (Dept. of Energy, Washington, DC). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This paper examines some of the programs the US Department of Energy has launched in its effort to make energy conservation both a part of the strategy of transition to more expensive energy sources and a permanent feature of society. Energy conservation efforts involve a large number of programs at all levels, and experience has shown that no single approach is possible that would drastically reduce consumption quickly and painlessly. National policies that affect nearly all consumers include, for example, residential and commercial tax credits for conservation improvements, promulgation of standards for energy efficiency in buildings and appliances, and promoting higher fuel economy in automobiles. Other prorgams are administered at the national level and implemented locally, including an energy conservation program for schools, hospitals and government buildings, an audit and information program for residential conservation, a weatherization assistance program, and a mandate to public utilities to review the feasibility of more efficient rate structures and developing more hydroelectric power. Finally, there are a number of federal programs specifically designed to enhance the capabilities of state and local governments to play an important role in conservation. Four such programs are examined closely. Also examined are three locally administered, independent programs which increased energy awareness and promoted conservation. The success of these programs, in spite of marginal federal involvement, suggests that future policy may make more use of locally oriented efforts. 9 refs.

15071 (EMR—9008, pp 20) **Determinants of conservation-oriented consumption: Sweden versus the United States.** Allen, C.T.; Schewe, C.D.; Liander, B. (Univ. of Massachusetts, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

This study examines the values and attitudes toward energy consumption and conservation in the USA and Sweden in order to make cross-cultural comparisons and identify factors which underlie efficient energy use. Surveys were conducted in two small cities, one in Massachusetts and the other in Sweden. The notion that Swedes, more than Americans, consciously and purposefully consume in a fashion to conserve energy, was not supported. Stronger perceptions of individual effectiveness, weaker materialistic values, and a belief that others are helping out with the energy predicament seem to underlie conservation-oriented consumption in both cultures. Although Swedes are less materialistic, they are less likely to view their own behavior as effective, and are more skeptical of what others are doing in helping out with the energy problem. In the study's most lopsided finding, New Englanders' perceptions of change in consumption were much stronger. Swedes are more alienated from a consumer role and more concerned about environmental protection. They do not perceive they have much influence on government decision making, but appear willing to let the government make the decisions on how to conserve energy. Herein perhaps lies the crucial difference between Americans and Swedes in the energy area. A conclusion given in this report is that governments can develop more effective energy policy when they have the flexibility created by a citizenry willing to be regulated. A policy alternative for reaching the affluent/heavy energy user in the USA is suggested, involving attempts to heighten individuals'

perceptions of personal involvement with the energy problem. 30 refs., 5 tabs.

15072 (EMR—9008, pp 22) **The residential energy consumption surveys of the Dept. of Energy: design and implementation.** Carlson, L.T.; Vagt, K.A.; Patinkin, L.D.; Thomson, W.H. (Dept. of Energy, US). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

The US Energy Information Administration designs, develops and implements ongoing data collection programs to obtain data on energy consumption and the components affecting energy consumption. This paper describes the evolutionary development and characteristics of the household and transportation panel surveys underway to determine energy consumed in the residential sector. In late 1976 the Residential Energy Consumption Survey was begun; it was planned to construct a survey design and data set to meet a wide range of user needs. Core data were to consist of information on households, their energy consumption and expenditures, housing, and household vehicles. The energy crises of the 70s brought about the need for timely data and made large-scale data collection impractical; interim small-scale surveys were then launched. This program was called the National Interim Energy Consumption Survey (NIECS) and included all the basic survey design components previously developed. Activities of NIECS are described related to ensuring good survey response rates, providing gasoline consumption data to the transportation panel, assessing the use of energy-consuming appliances and the energy quality of the housing stock, and taking into account the effects of weather. Some findings from NIECS are summarized in the areas of conservation, consumption, regional differences, and the effects of housing structure. Uses of the data are also outlined; these include forecasting of potential impacts of natural gas deregulation, and studying the feasibility and potential impact of requiring existing homes to meet minimum energy standards. 4 figs., 3 tabs.

15073 (EMR—9008, pp 23) **Complexities of household energy consumption and conservation.** Claxton, J.D.; McDougall, G.H.G.; Ritchie, J.R.B. (Univ. of British Columbia; Wilfrid Laurier Univ.; Univ. of Calgary). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

A national sample of Canadian households was used to relate climatic variables, dwelling/appliance/vehicle descriptors, demographic characteristics, and attitudinal variables to actual in-home energy consumption, and self-reported gasoline consumption. Using split-sample replications, dwelling and vehicle descriptors indicated strong association with energy consumption, while both male and female attitudes indicated weak associations. Some specific findings included the following. In-home energy consumption increased with lower winter temperatures, increased house size, and increased number of stories; reduced consumption was associated with electric space heating. Households with large families consumed more energy. Household income had a strong association with consumption. There was no significant association between consumption and the age of the male household head, the number of appliances owned, or attitudinal variables. As for gasoline consumption, this was positively associated with the number of vehicles in the household and their mean weight. It also appears that the presence of vehicles less than 5 years old tended to mean lower gasoline consumption. No significant relation was found between gasoline consumption and regional or climatic variables. Family-related variables that had a positive influence on gasoline consumption were number of miles driven, number of drivers in household, and the fact that both parents worked. House and vehicle descriptors explained 40% of in-home gasoline consumption while income explained only 10%. The implications of these findings to conservation policy are discussed. 28 refs., 4 tabs.

15074 (EMR—9008, pp 23) **Household behavior and energy use.** Verhallen, T.M.M.; van Raaij, W.F. (Tilburg Univ., Rotterdam, NL). 1980. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum. (CONF-8009100—; CE—02307).

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

The factors that determine energy use for home heating in the Netherlands were studied through interviews and energy consumption monitoring, From energy-related attitude statements, three basic factors emerge: energy consciousness, home comfort, and price consciousness. Attitudes predict household behavior only to a limited degree. Household behavior itself proved to be an important, but not yet very well investigated, determinant of energy use. Eight components of household behavior are related to energy use: bedroom temperature while sleeping, home temperature while absent, home temperature while at home, use of curtains, ventilation of rooms, and use of bedrooms except while sleeping. Home characteristics (insulation, wind orientation) are another important determinant. Together, household behavior, home characteristics, special circumstances such as extent of occupancy, attitudes, and sociometric characteristics explain 58% of the variance in energy use. A model is proposed to structure these determinants of energy use. Home insulation proved to have two opposing effects on energy use: lower home temperatures but more ventilation-related behavior. Recommendations for four types of energy conservation campaigns are proposed and evaluated from the results of this study. Campaigns persuading consumers to change their household behavior, and direct feedback campaigns that inform consumers about their consumption of energy and its costs, probably have more potential than attitude-change campaigns. 13 refs., 4 figs., 8 tabs.

15075 **(EMR—9008) Consumer behavior and energy use.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1980. 584p. (CONF-8009100—; CE—02307). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From Conference on consumer behavior and energy use; Banff, Canada (17 Sep 1980).

A conference was convened to provide an overview of major empirical studies in the area of behavioral research related to energy consumption and conservation. Papers were presented in the areas of national and international perspectives of consumer energy behaviors, methodological issues in consumer behavior research, consumers and travel, energy conservation programs implemented by governments and electric utilities, household energy decision making, financial incentives and disincentives, energy information and its relation to product purchase decisions, solar energy and the consumer, and the impact of conservation programs. Separate abstracts have been prepared for 29 papers from this conference.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 14254, 14254, 14257, 14279, 14630, 15092, 15273, 15388, 15728

15076 **(CONF-881256—1) Some fundamental factors affecting the durability of coal/water slurry injectors in diesel engines.** Sekar, R.R.; Wang, C.S.; Choi, U.S. (Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004198/JAW.

From Power generation conference; Orlando, FL, USA (6 Dec 1988).

The service life of an injector nozzle in a diesel engine fueled with a coal/water slurry (CWS) is 2-5 h, which limits the continuous running time of the engine. This study of CWS flow

and erosion in injector nozzles was initiated to provide an analytical tool, validated by experiment, for designing a durable injector and predicting long-term wear from limited test runs. The two-phase hydrodynamic theory of solid/liquid slurry flow has been extended to incorporate the constitutive relationship for power-law non-Newtonian behavior. A computer model has been developed to predict the spatial and temporal variations in solid and liquid velocities, viscosities, and concentrations under the high shear rates encountered in diesel injection systems. The model has been validated using Newtonian, single-phase flow data obtained with water or No. 2 diesel fuel and non-Newtonian, two-phase flow data using a CWS. The computed and measured viscosities and shear rates showed good agreement. Viscosities of four micronized CWS samples were measured at shear rates between 3,000 and 30,000 sec/sup {minus}1/ in a high-pressure/high-shear capillary tube system or a rotational viscometer. The complex CWS flow at high shear depended on coal particle size, temperature, coal loading, additivies, and the shear rate. 22 refs., 14 figs., 4 tabs.

15077 **(DOE/CE/90236—T1) Effect of cylinder distortions and piston ring design on oil consumption and friction losses in automobile engines.** Brombolich, L.J. (Compu-Tec Engineering, Chesterfield, MO (USA)). Jul 1988. Contract AC02-86CE90236. 202p. NTIS, PC A10/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006110/JAW.

Much analysis has been done on piston ring design in circular cylinder bores; however, engine bores are never perfectly circular. Mechanical loads, from machining operations and assembling the engine, and thermal loads cause distortion of the engine bores. Engine bore distortions are important in predicting the effectiveness of piston rings to control oil consumption, yet minimize friction in spark ignited engines. Only recently has the effect of these bore distortions been investigated. The RING program has been developed to analyze ring conformability in distorted cylinder bores. In particular, oil transport and friction are predicted for the engine cycle. The finite element technique was used in a non-linear contact solution for the piston ring pack in a distorted bore. The inter-ring gas pressure loads and piston and ring dynamic loads are computed for the ring pack. The Reynolds' equation is solved for lubricant film thickness. Hydrodynamic or boundary friction power losses are calculated based on the lubricant film thickness between the ring and bore. During development of the program, correlation of results were made with experimental measurements. Oil consumption and friction measurements of operating production engines with measured bore distortions were compared with results from the RING program. Predicted gaps between the piston ring and distorted bore were verified with measurements of gaps for a ring in a ring gage. Results from the RING program and the correlation analysis confirm the importance of distortions in predicting engine performance. Bore distortions should also be considered in predicting emission and wear in reciprocating engine designs to improve engine performance and life. 106 refs., 70 figs., 7 tabs.

15078 **(NEI-FI—65) Development project for dual-fuel diesel power. Preliminary study.** Aho, S. (Imatran Voima Oy, Helsinki (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Oct 1987. 35p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756282/JAW.

This prestudy estimates the competitiveness of a dual-fuel diesel power plant in heat and power (CHP) production. The dual-fuel power plant is developed by Waertsilae Diesel and it relies on high-pressure injection. The prestudy also considers electric power generation costs for the plant and the market in Finland and in potential purchasing countries. The prestudy is part of a more extensive development project for gas-diesel power plants. The aim of the project is to develop a complete gas-diesel power plant to build in Finland and abroad. The prestudy shows that Waertsilae's new VASA 32 gas-diesel power plant is more competitive in CHP-production than conventional gas-diesel and gasturbines. However, its economy should be improved. The profit, or internal rate, of the investment, which varied from 0-4% in alternatives that were studied, is clearly smaller than the requirement for investments of this type. In Finland the current market for gas-diesel power plants is small in the area included in the gas network. There are about ten suitable municipalities. In most of them only one unit can be considered, the total potential thus amounting to about 100 MW. In fact, the markets for new gas-diesel power plants can be found elsewhere. The most important market areas for the plant will be CHP-production and co-generation mainly in industrialized countries, developing countries, technical markets for gas-industry and oil-industry, mere electricity generation in industrialized countries. The economy of the power plant can be improved by raising the coefficient of efficiency with e.g. a Power-Turbine and by decreasing operation and maintenance costs through automation. The investment planning, modularity and standardization of small power plants can also be developed.

15079 **(NP—9770225) CARS-studies on an Otto engine.** Hassel, E. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 14 Nov 1986. 86p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770225/JAW.

The aim of the research programme described in detail was to carry out temperature measurements and measure the CO/sub 2/ and O/sub 2/ content in a single cylinder Otto engine using a novel laser-based method. The report first covers the theoretical basis of this CARS (Coherent Anti Stokes Raman Scattering) spectrometry, then on the specialist literature dealing with the practical application of CARS in studying engine combustion processes. Details are then given on the experimental setup (object of the experiment, measuring instruments, preliminary experiments) and the measuring programme CARS-single-shot spectra of N/sub 2/, O/sub 2/, CO/sub 2/ molecules at a measurement site on different crank shaft positions. Results of measurements of temperature processes and concentrations from the O/sub 2/ and CO/sub 2/ spectra. The overall finding is that this measuring technique is suitable for measuring temperatures and concentrations in real combustion chambers, even at high pressure. (HWJ).

15080 **(NP—9770226) Improvement of charging in a diesel engine by means of an exhaust turbo-charger with variable geometry.** Buerki, T. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1985. 148p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89770226/JAW.

Turbosupercharged diesel engines provide only small torque at low revs if a non-regulated turbine is used. However, those regulating systems hitherto known to be good gave rise to design problems. This was the reason why a different path was chosen. It excels in simplicity of design, high operational safety and resistance to fouling. Details are given of the radial turbine with variable impeller inlet-area, in which the only moving component is a shell fitted with blades, pushed axially into the gas flow and not dependent on a close fit or guide mechanisms. This means that it is less susceptible to malfunction, the regulating mechanism is simple, and the gap losses are smaller as well. This shell is connected to the turbine casing by means of a metal ball which acts as a regulator at the same time, so that a sudden rise of engine torque can be achieved at low revs. This regulating mechanism also improves acceleration power and greatly reduces exhaust emmission in the engine. (HWJ).

15081 **(VW-FAG—8702V/5) Thermally insulated passenger car diesel engine with exhaust energy recycling.** Langer, M. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.). Abt. Forschung und Entwicklung). 4 Jun 1987. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756627/JAW.

The work documented in this report was done as part of a research project funded by the Federal Ministry for Research and Technology. The final report presents the results of development work on thermally insulated passenger car diesel engines by comparison with conventional power units and assesses the chances for utilising exhaust energy by means of composite units. The ceramic materials aluminium titanate and zirconium dioxide were used in the development of the components required for thermal insulation of the combustion chamber. Both swirl chamber and direct fuel injection engines in the naturally aspirated and supercharged versions were integrated into the experiments. The theoretical positive effects of thermal insulation in combustion spaces on engine efficiency were not borne out by the practical experiments. The major rea-

sons were a higher level of wall heat losses and a change in the combustion process with negative effects on the efficiency rating of the engine. The conclusion is that thermal insulation of the combustion chamber is not recommendable from the thermodynamic point of view. The computations of various composite arrangements for utilising the higher exhaust energy-content in thermally - insulated engines produce only slight benefits in the upper characteristic field in terms of engine performance, torque and consumption. For passenger car engines, which operate mainly at partial load, the benefits do not justify the expense and effort.

15082 **Effect of intake valve configuration on lean combustion.** Chau, E.L.; Schipperijn, F.W.; Nagasaka, R.; Sawyer, R.F.; Iiyama, A. Warrendale, PA; Society of Automotive Engineers (1988). 12p. (CONF-880241—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and exposition; Detroit, MI, USA (29 Feb 1988).

Technical Paper 880202.

A comparative study of flame kernel development, flame propagation, and energy release rates for port fuel injected, lean engine combustion reveals effects of intake valve configuration. High speed schlieren motion pictures of combustion in a square piston engine simulator record the flame development histories for three different cylinder heads at two mixture ratios. The three cylinder heads are a four valve head with centralized spark plug, a two valve head with centralized spark plug, a two valve head with helical swirl intake port, and a two valve head with straight intake port. Observation at two pentaine/air mixture ratios, stoichiometric or slightly rich and near the lean limit, compares intake flow and fuel/air mixture effects on combustion processes. Color schlieren motion pictures reveal qualitative features of both the intake flow and combustion event. Image processing of selected frames from black and white schlieren motion picutres produce quantitative burn rate data. Early flame development patterns are markedly different for the different intake valve configurations. Stoichiometric flame kernel development is more than 1.6 times faster than the lean burn case for the four valve head, 1.3 times for the swirl port, and 1.8 for the straight port. Volume burn data show cycle to cycle variations near the lean limit is due to poor flame kernel development rather than poor flame propagation.

15083 **Environmental effects in toughened ceramics.** Hecht, N.L.; McCullum, D.E.; Graves, G.A.; Jang, S.D. (Univ. of Dayton Research Inst., 300 College Park, Dayton, OH (US)). pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

A study is being conducted on the effects of environment on the mechanical behavior of transformation toughened ceramics for advanced heat engine applications. The primary goal is to determine the effects of environment on toughening, strength, and crystal structure in commercially available transformation toughened ceramics. Emphasis is focused on understanding the mechanisms responsible for environmentally induced strength degradation and crystal changes in the temperature range 25° to 1050°C. The information and insight obtained from this program will be used to evaluate long-term applicability of toughened zirconia as diesel engine components.

15084 **A practical system for the use of alcohol in diesel engines.** Urbana, IL; Coordinated Science Laboratory (1987). 322p. Coordinated Science Laboratory, Univ of Illinois at Urbana-Champaign, 1101 W Springfield Ave, Urbana, IL 61801.

The widespread use of diesel engines in the farm community coupled with the capability to produce fuel grade ethyl alcohol from farm grains has generated extensive research into the use of ethanol as an alternate diesel fuel. Since ethanol's basic combustion characteristics and consequent low cetane number make it a poor diesel fuel when directly injected into diesel engines, most studies have emphasized either mixtures of alcohol and diesel fuel or dual fueling systems such as fumigation of the alcohol with the inducted air charge. This study utilized fumigation of ethanol with the aim of developing a simple and practical microchip controlled alcohol injection system suitable for all engine operating conditions. In contrast to most previous fumigation systems, the method selected used multiple injectors with one at each inlet valve location. The results of the investigation have shown that alcohol fumigation of diesel engines is practical in terms of energy replacement and in terms of proof level of alcohol needed.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 14564

15085 **(DOE/NASA—5266-1) Comparison of NASA Lewis Research Center's performance code's pressure drop model predictions to Stirling Engine working-space flow test data.** Sullivan, T.J. (Sverdrup Technology, Inc., Cleveland, OH (USA)). Dec 1988. Contract AI01-85CE50112. 18p. (NASA/CR—182215). NTIS (US Sales Only), PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006615/JAW.

In support of the US Department of Energy's Stirling Engine Highway Vehicle Systems program, the NASA Lewis Research Center's Stirling engine performance code's pressure-drop model was validated in this study. The validation was accomplished by comparing P-40 Stirling engine working-space pressure-drop prediction to experimental data for various steady flow test conditions. This report includes details of the flow test rig and the working-space pressure-drop predictions. After making various improvements to the Stirling engine pressure-drop model, the comparison showed good agreement between the working-space pressure drop predictions and the flow rig data. 6 refs., 7 figs., 3 tabs.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 14942, 15651

15086 **(DSMA—1093/1170) Interim technical report on the evaluation and development of electric vehicles.** Ferguson, D.; Andres, D.; Tillson, J.; Dafoe, J.; Smith, W. (DSMA Atcon Ltd., Toronto, Ontario (Canada)). 1981. vp. (CE—02180). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A program was conducted to evaluate and develop Canadian electric vehicles under typical Canadian operating conditions. In this program, a fleet of electric vehicles was purchased and operated at a site in Ontario along the St. Lawrence Seaway. This report presents the results of the fleet operations and a summary of other program activities completed. The fleet logged a total of just over 10,000 km of operation, and vehicles have been modified to incorporate improvements developed during the program. A static test rig was also used to investigate problems and evaluate alternative components. The vehicles have successfully performed their assigned duties under somewhat adverse conditions, with loading levels running 15-25% above the manufacturer's listed gross weight, routes including grades of up to 6% with some gravel sections, and unenthusiastic drivers. Under these conditions, the vehicles have a serviceability record of 86% including downtime for product improvement. Mean time between failures has been 406 km for all events reported. The operating range obtained in the test was 15-25 km depending on battery and ambient temperatures, which is significantly less than the figure claimed by the manufacturer. Service problems indicate that further product improvements are desirable but these problems are not considered excessive for a vehicle that is essentially a production prototype. Appendices are included that give detailed vehicle and component descriptions, test results, specifications, and information on the monitoring instrumentation. 71 figs.

15087 **(EGG-M—88466) Group testing of lead-acid batteries for electric vehicles.** Burke, A.F.; Hardin, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1989. Contract AC07-76ID01570. 11p. (CONF-890160—1). NTIS, PC A03 - OSTI. Order Number DE89005415/JAW.

From Battery conference on application and advances; Long Beach, CA, USA (17 Jan 1989).

This study was concerned with the module variability of three lead-acid battery packs--namely, 120 V ALCO 2200, 108 V EV-2300, and 96 V Gel/Cell batteries. Each battery pack was discharged for a range of constant powers and over The Simplified FUDS. A microcomputer-based (IBM XT) data acquisition system was used to obtain module and pack voltage data at selected times during the discharges. For each time Lotus 1-2-3 software was used to determine the average, maximum and minimum module voltages and the standard deviation (STD) of the module voltages. It was found that the STD varied from a minimum of about 0.015 V to a maximum of 0.5 V for the batteries tested. The module variability of the ALCO 2200 batteries was much smaller than that of the EV-2300 batteries at all states-of-charge and currents up to 400 A. The Phase 3 Gel/Cells had module variability comparable to that of the ALCO 2200 for SOC > 40%, but the variability of the Gel/Cells increased rapidly at lower states-of-charge. The module variabilities resulted in differences in module capacities of up to 12% for discharge schedules requiring high power (400 A). 3 refs., 11 figs., 1 tab.

15088 **Status of electric and hybrid vehicle technology.** Brown, P.J. (Electric and Hybrid Propulsion Div., D.O.E., Washington, DC (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

This paper reports on the current and future status of the electric and hybrid vehicle technology including battery and propulsion system research and development. Improvements in the state-of-the art of currently available electric vehicles will be compared with electric vehicles available when a testing and evaluation program was initiated. An overview of the international and efforts in electric vehicle technology developments and an assessment of the future commercialization prospects are presented.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 15088

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 15389

15089 **(LBL—26552) Effects of glazing and ventilation options on automobile air conditioner size and performance.** Sullivan, R.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). 30 Dec 1988. Contract AC03-76SF00098. 126p. (TA—259). NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007087/JAW.

The Lawrence Berkeley Laboratory has performed a preliminary analysis of the effects of glazing and ventilation on automobile cooling loads and air conditioner capacity limits. The study was accomplished as part of the Environmental Protection Agency's efforts to reduce the release of chlorofluorocarbons into the earth's atmosphere from automobile air conditioners. We investigated the characteristics of standard and sports-model sedans using numerical simulations of the heat transfer processes under static-soak conditions. In addition, an annotated bibliography was created that documents other relevant research to both static-soak and highway driving conditions. The studies and our own results suggest that: Glazing is a major contributor to the cooling loads that dictate the size of automobile air conditioners; The use of new glazing technology in conjunction with other design features, e.g., ventilative cooling when parked, provides a viable means of reducing cooling system size in many parts of the counter; and Continuing work is needed to perform additional analytical and experimental investigations under highway driving conditions that will document the magnitude of the cooling unit size reduction possibilities. 15 refs., 16 figs., 4 tabs.

3307 Emission Control

REFER ALSO TO CITATION(S) 14224

15090 **(UBA-FB—85-018) Research for a procedure developed for exhaust gas testing under the periodic inspection of catalyst motor vehicles. Final report.** Hassel, D.; Weber, F.J.; Richter, A. (Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.). Zentralabteilung Verkehrs- und Transporttechnik; Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Pruefstelle fuer die Abgase von Kraftfahrzeugen; Umweltbundesamt, Berlin (Germany, F.R.)). Aug 1985. 106p. (In German). Copy held by UB/TIB Hannover.

The task of the research project was to examine two short test procedures proposed by the Federal German Environmental Agency for their durability in detecting high-emitting catalyst-equipped vehicles ('test failures'). To this end, and after previous agreement with the vehicle manufacturers concerned, potential non-conformities were simulated and the vehicle emission behaviour measured. For this purpose, three vehicles each were made available to TUeV Rheinland und RWTUeV Essen. Simulation of incorrect settings or defective parts proved that the proposed test procedures were basicly capable of detecting high-emission vehicles. The examinations showed that the detection of non-conformities acquires measurements of CO and NO concentration levels behind the catalysts. In some cases, and in particular misfuelling, the HC concentration was an additional indicator of potential non-conformity. The measurement taken under load when compared to the measurements under high idle were more effective in recognizing the various simulations of non-conformities. In particular the higher concentration levels of nitrogen oxides made it possible to more reliably detect non-conformities using the available equipment. In terms of vehicle emission reduction systems that use an exhaust gas recirculation system, which normally responds only under partial load, the measurements proved the functionability of the EGR-System under load. (orig.) With 6 refs., 14 tabs., 104 figs.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 14224, 14279, 14324, 14942, 15012, 15084

15091 **(DE—8008) Broad-cut fuels for automotive diesel engines. A feasibility study.** (Davis Engineering Ltd., Ottawa, Ontario (Canada)). 1980. 184p. (CE—02265). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An increasing demand for diesel fuel in Canada has led to a search for ways of increasing or extending the diesel fuel supply. This report considers an aspect of increasing this supply by blending in lighter fuels. A blending stock of particular interest would be naphtha, which cannot be used economically as blending stock in high-octane unleaded gasoline because of its low cetane number. Blending naphtha into automotive diesel fuel would thus both alleviate the diesel fuel supply situation and eliminate possible naphtha surpluses created by the switch to unleaded gasoline. In the first part of this report, diesel fuel demand forecasts are made for different Canadian regions, and are used to assess what changes, if any, will be required in the diesel fuel specifications to permit production of the required volumes of fuel. Results show that, if an intermediate estimate of demand is considered, future diesel fuels will have lower cetane numbers than those now produced but broadening the cut to include more naphtha will be required only in Ontario and Quebec. The second part of the report presents results of research on diesel engines in order to establish the tolerances of these engines to the kinds of diesel fuels expected to be available to satisfy demand in 1985 and 1990. Road tests were also performed to determine if broad-cut fuels had any adverse effects on driveability. In general, it was found that those fuels did not degrade driveability, performance, fuel economy, or exhaust emissions compared to

conventional fuels. However, safety of those fuels, due to their relatively low flash point, is yet to be established. 14 refs., 29 figs., 42 tabs.

15092 **(DOE/CH/10093—H5) Design and testing of a dissociated methanol vehicle.** Karpuk, M.E. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1989. Contract AC02-83CH10093. 107p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007051/JAW.

The concept of dissociating methanol with exhaust gas heat to improve the efficiency of methanol-burning engines has often been described in the literature. The concept has been controversial with conflicting results from analysis and experimentation. In this report, we describe the design and testing of a dissociated methanol vehicle based on a Ford Escort. This work draws heavily on the experience gained by Finegold et al. (1984) when they built a dissociated methanol Chevrolet Citation at the Solar Energy Research Institute (SERI). The improvements that we incorporated into the dissociated methanol Ford Escort include a very active, custom palladium on γ-alumina dissociation catalyst, a liquid methanol injection system for starting and high power operation, and a custom microprocessor-based engine controller provided by Ford Motor Company. The goal of the work described in this report was to design, build, and test a dissociated methanol vehicle to measure the fuel economy and emissions benefits compared to lean burning liquid methanol. The original test plan called for transient testing using the EPA city and highway driving cycle tests. However, technical and funding problems prevented that testing. Steady-state vehicle testing was performed that revealed many of the benefits and problems of the dissociated methanol concept. 19 refs., 40 figs., 14 tabs.

15093 **(FRNC-TH—3389) Study of a neutralization process of vegetable oils used as diesel fuel.** Masson, C. (Institut National Polytechnique, 31 - Toulouse (France); Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 157p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756633/JAW.

The neutralization of palm oil, palm kernel oil and rapeseed oil is realized by esterification of free fatty acids with methanol and ion exchange resins as catalyst. Influence of temperature, methanol concentration water and catalyst are examined. Replacement of methanol by ethanol is also investigated. Optimization of performance is studied on a 10 liter micropilot plant.

15094 **(NP—9770214) Technical and economic aspects of various possible uses of ethanol in the fuel sector.** Funk, H.; Schmoltzi, M. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.). Inst. fuer Landwirtschaftliche Marktforschung). Apr 1985. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770214/JAW.

The technical and economic aspects of the various possible applications of ethanol in the fuel sector are demonstrated. The trend for lead-free petrol could produce new incentives for the use of ethanol. Detailed reports are provided on the application of ethanol in internal combustion engines (ethanol as a mixing component: Increase in octane number, use as solvent; utilization in component synthesis; ethanol as pure fuel) and in the area of diesel engines. Information on this subject covers the diesel fuel-alcohol mixture (stability of the mixture, combustibility), the synthesis of diesel replacement fuels (vegetable oil esters: Production of vegetable oils, transesterification, economic viability) and their application in adapted engines. Finally a report is given on the effects of the use of this alternative fuel ethanol on fuel supplies. (HWJ).

15095 **(VW-FET—8604V/4) Alternative energy for road transportation - subproject on fuel alcohols - M100/petrol alternating concept. Final report.** Decker, G.; Steinke, D. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.). Abt. Forschung und Entwicklung). 25 Aug 1986. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756628/JAW.

For the last several years, programmes of experiments with alcohol-powered vehicles have been going on in Federal Germany and a number of other countries. As the range of these vehicles is very restricted because of the very small number of fuel filling stations, a concept was developed that could be run either on M100 fuel/or petrol in which all the advantages of the concept are maintained under M100 and petrol operation is regarded as 'emergency only' with restricted driving performance. The power unit is a 1.8 liter engine optimised for M100 operation. The mixture former is a digital fuel injection system with a memory for the mixture-formation and ignition data relating to both fuel types. Measurements taken on a vehicle with an unregulated catalytic converter showed that emissions are well below the limits stipulated in Appendix XXV of the StVZO (Road Traffic Act) for both fuel types. With a NO/sub x/-optimised tuning and M100 fuel operation, the emissions will be below the limits laid down in Appendix XXIII.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 14459

15096 **(IAEA-INFCIRC—349) Stockholm declaration.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705323/JAW.

The Stockholm Declaration was adopted on 21 January 1988 in Stockholm by the President of Argentina, the Prime Minister of Greece, the Prime Minister of India, the President of Mexico, the Prime Minister of Sweden and the President of the United Republic of Tanzania and it expresses the position of these states concerning nuclear disarmament.

3503 Verification

15097 **(K/ITP—241) A layman's guide to constitutional aspects of international arms control agreements involving the United States.** Scheinman, L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1988. Contract AC05-84OT21400. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006331/JAW.

An initial assessment has been conducted to examine the legal implications and complexities that must be understood and evaluated should the facilities and contractors of the US Department of Energy (DOE) not be exempted from on-site inspections (OSIs) conducted by the Soviet Union under the pending Strategic Arms Reduction Talks (START) Treaty or under future arms control treaties. The assessment looks at the Fourth Amendment rights (right to be secure from unreasonable searches and seizures) of parties at government-owned; government-owned, contractor-operated (GOCO); and private sector facilities that are candidates for Soviet suspect site inspections (SSIs). In particular, the assessment examines the legal consequences of putting at risk classified information designated as either National Security Information (NSI), as cited in relevant executive orders, and/or Restricted Data (RD), which is defined in the Atomic Energy Act of 1954 as amended. Given the potential risk of inadvertent losses of RD and other classified information at DOE sites during OSIs, the Division of Policy and Technical Analysis of DOE's Office of Arms Control (OAC) commissioned this study to aid in understanding some of the legal aspects that must be considered to prepare DOE facilities for possible future OSIs.

15098 **(SAND—89-0103C) Radiation detection in treaty verification.** (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 37p. (CONF-890124—1-Vugraphs). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005925/JAW.

From American Association for the Advancement of Science (AAAS) annual meeting; San Francisco, CA, USA (14 Jan 1989).

Article VII, paragraphs 8 and 14, of the inspection protocol of the INF Treaty between the US and the USSR provides for the use of radiation detection devices as a verification tool. That is, the Treaty allows the parties to measure the radiation from the radioac-

tive components of nuclear weapons in order to verify that the inspected party is complying with the Treaty. This is the only verification provision in the Treaty that addresses the nuclear components of the relevant weapon systems. Acceptance of and confidence in such measurements is a significant development and similar measurements may be needed for verification of future treaties.

36 MATERIALS

REFER ALSO TO CITATION(S) 15585

15099 **(X-EP-LMS-RA—1985) Annual report of the Solids Mechanics Laboratory, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 540p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756705/JAW.

Research on the plasticity of metals and soils; fracture mechanics; shell stability and deformation; homogenization; rheology of rocks as a function of temperature; rheology of wood; similitude in dynamics and quasi-statics; anchoring; vibrothermography; calculation of the stability of underground structures; composite materials; soil reinforcement; and wave propagation is presented.

15100 **(X-EP-LMS-RA—1986) Annual report of the Solids Mechanics Laboratory, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 40p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756706/JAW.

Research on branching and stability in plasticity and fracture; rock mechanics; damage and fatigue; expertsystems; and soil mechanics is presented. Nuclear waste disposal in geological formations is considered.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 14250, 14545, 14641, 14663, 14663, 14712, 14718, 14718, 14718, 14722, 14722, 14742, 15262, 15276, 15373, 15402, 15517, 15525, 15534, 15535, 15549, 15550, 15564, 15567, 15668, 15711, 15724, 15726, 16529, 16595, 16602, 16613, 16638

15101 **(AGA—9006593) Evaluation of stress-corrosion cracking resistance of newly developed grade X70 and X80 line pipe steels.** Christman, T.K. (Battelle Columbus Div., OH (USA)). 17 Aug 1988. 23p. American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209. Order Number TI89006593/JAW.

The report describes the results of an evaluation of the stress-corrosion cracking (SCC) resistance of three high-strength, line pipe steels. These steels included an X70 grade containing Mn, V, and Cb, with a ferritic-bainitic microstructure; an X70 grade containing boron (B), with a bainitic structure; and a ferritic X80 grade microalloyed with Mo, Cb, V, and Ti. All three of these steels have been shown, in previous A.G.A. research programs, to have excellent strength, toughness, and resistance to hydrogen sulfide attack. The specimens were evaluated using the standard tapertension specimen test, in which a specimen of varying cross-section is cyclically stressed in a hot carbonate-bicarbonate solution at a cracking potential. After cycling, the specimen is examined for cracking and the threshold stress level for stress-corrosion is determined. The B-free X70 steel had a stress-corrosion threshold stress of at least 42 ksi (60 percent SMYS). The B-containing X70 steel had a threshold stress of 50 ksi (70 percent SMYS). The X80 grade had the highest threshold both, in terms of absolute stress (60 ksi) and fraction of SMYS (75 percent). In addition, the crack growth rates for the X70 steels appeared to be lower than those of more conventional grades, although those rates could not be accurately quantified in this program. The X70, B-containing grade and the X80 steel both appear to have significantly better SCC resistance than conventional steels. In particular, the X80 grade may provide a threshold stress for SCC that exceeds the normal operating hoop stress of the pipe. 5 refs., 8 figs., 6 tabs.

15102 **(BNL—41956) The energetics associated with the formation of interfaces, multilayers and adlayers.** Watson, R.E.; Weinert, M.; Fernando, G.W.; Davenport, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-8811147—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005642/JAW.

From Symposium on atomic scale calculations in materials science; Boston, MA, USA (28 Nov 1988).

A combination of bulk and slab total energy calculations have been done to disentangle the energetics of metal adlayer and multilayer formation. Results have been obtained for Pd/Nb(110), Pd/Nb(001), Ag/Nb(110), Ag/Nb(001) and Nb/Pd(111) which provide a picture consistent with what is known experimentally for these systems. 3 refs., 2 figs.

15103 **(BNL—41959) Positron spectroscopy for materials characterization.** Schultz, P.J.; Snead, C.L. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 45p. (CONF-880901—15). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005766/JAW.

From Metallurgical Society fall meeting and American Society for Metals materials week; Chicago, IL, USA (24 Sep 1988).

One of the more active areas of research on materials involves the observation and characterization of defects. The discovery of positron localization in vacancy-type defects in solids in the 1960's initiated a vast number of experimental and theoretical investigations which continue to this day. Traditional positron annihilation spectroscopic techniques, including lifetime studies, angular correlation, and Doppler broadening of annihilation radiation, are still being applied to new problems in the bulk properties of simple metals and their alloys. In addition new techniques based on tunable sources of monoenergetic positron beams have, in the last 5 years, expanded the horizons to studies of surfaces, thin films, and interfaces. In the present paper we briefly review these experimental techniques, illustrating with some of the important accomplishments of the field. 40 refs., 19 figs.

15104 **(BNL—42092) The influence of surface capacitance on the measurements of localized corrosion transients.** Isaacs, H.S.; Davenport, A.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-881061—13). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006172/JAW.

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Difficulty is encountered in measuring the early stages of localized corrosion transients because of the charging of the capacitance of the passive surface surrounding the actively corroding area. Measurements of the transmission of potential pulses have been carried out on wire electrodes and show that the propagation rate of the signal was that expected from the product of the surface capacity and solution resistance. 6 refs., 6 figs.

15105 **(CEA-CONF—9579) Low temperature phase transitions in the heavy electron compound YbSb.** Bonville, P.; Broto, J.M.; Fert, A. and others. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 9p. (CONF-880705—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756410/JAW.

From International conference on magnetism (ICM '88); Paris, France (25 Jul 1988).

Using Mossbauer spectroscopy on /sup 170/Yb, we detected two low temperature phase transitions in the heavy electron pnictide YbSb. Below T/sub N/= 0.32K antiferromagnetic ordering of Yb/sup 3+/ develops, and between 0.32K and 5K a phase exists whose nature is yet undetermined. Magneto-transport measurements confirm the heavy electron properties and the 5K phase transition.

15106 **(CEA-CONF—9580) Moessbauer relaxation measurements on Yb in LaBe/sub 13/ and in YbBe/sub 13/: influence of Kondo effect and superconductivity.** Bonville, P.; Imbert, P.; Jehanno, G.; Gonzalez-Jimenez, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF); Facultad de Ciencias, Caracas (VE)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 8p. (CONF-880705—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756411/JAW.

From International conference on magnetism (ICM '88); Paris, France (25 Jul 1988).

Low temperature Moessbauer measurements are reported on /sup 170/Yb in LaBe/sub 13/ and in YbBe/sub 13/. Paramagnetic relaxation of Yb/sup 3+/ was analysed and interpreted in terms of a Kondo behaviour of Yb/sup 3+/ in these alloys. A superconducting transition was found in LaBe/sub 13/ at about 0.27K.

15107 **(CEA-CONF—9598) Progressive buckling under both constant axial load and cyclic distortion.** Clement, G.; Acker, D.; Lebey, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 14p. (CONF-880962—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756413/JAW.

From 6. international conference on pressure vessel technology; Beijing, China (11 Sep 1988).

Thin structures submitted to compressive loads must be carefully designed to avoid any risk of ruin by buckling. The aim of this paper is, first, to evidence that the critical buckling load may be notably lowered when cyclic strains are added to the compressive load and, secondly, to propose a practical rule of prevention against the ruin due to the progressive buckling phenomenon. This rule is validated by the results of numerous tests related to the entire range of modes of buckling (i.e. from fully plastic to fully elastic). Practical cases of interest for its use could mainly be those where cyclic thermal stresses are involved.

15108 **(CEA-CONF—9600) Fatigue analysis of crack-like defect experimental verification of practical rules to predict initiation.** Autrusson, B.; Moulin, D.; Acker D.; Barrachin, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 13p. (CONF-880962—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756414/JAW.

From 6. international conference on pressure vessel technology; Beijing, China (11 Sep 1988).

This paper presents an experimental verification of analysis methods aiming at predicting initiation of cracking by fatigue in crack-like defects existing on start up of pressure vessel components. A few calculation methods available in the literature and usable by design engineers are selected. Some of them are given by the french construction codes like RCC-M or RCC-MR. They are applied and compared with numerous experimental results obtained on austenitic steel specimens. The comparison of results reveals a satisfactory correlation with the simplest method based on elastic stress component calculated at 0.05 mm distance from the surface crack and on the classical design fatigue curve relevant for the material. The elastoplastic methods that permit a more precise evaluation of real strain range lead to more complex calculations and require the use of the design fatigue curve too. The plastic zone size, stress triaxiality and experimental initiation detection influence the results.

15109 **(CEA-CONF—9611) Moessbauer and muon spin relaxation studies of the rare earth magnetic ordering in high T/sub c/ superconductors.** Dalmas Reotier, P. de; Vulliet, P.; Yaouanc, A.; Chaudouet, P.; Garcon, S.; Senateur, J.P.; Weiss, F.; Hartmann, O.; Karlsson, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR). Dept. de Recherche Fondamentale; INPG/ENSPG, 38 -Saint-Martin-d'Heres (FR); Universite Joseph Fourier, 38 -Grenoble (FR)). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756416/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

We have studied the magnetism of the Gd sub-lattice by μSR and /sup 155/Gd Mossbauer spectroscopy from 65 mK to 3 K. The normalized local magnetic field at the two nuclear probes has the same temperature dependence which strongly deviates from a Curie-Weiss mean field behavior. The localization site of the muon is discussed.

15110 **(CEA-tr—2253) Forged and rolled heat resistant austenitic steel X5 NiCrTi 26 15.** (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1988. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756664/JAW.

Specifications of the steel, for pressure vessels up to 700/sup 0/C, are given: composition, mechanical properties, testing.

15111 **(CONF-880726—8) Effect of projectile mass on amorphization of CuTi.** Koike, J.; Okamoto, P.R.; Meshii, M. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). Sep 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005886/JAW.

From 4. international conference on structure of non-crystalline materials; Oxnard, CA, USA (18 Jul 1988).

Various intermetallic compounds are shown to be amorphized by electron and ion irradiations below a critical temperature. the critical temperature for amorphization is higher for ion irradiation than for electron irradiation. In the present work, the effect of projectile mass is studied in amorphization of CuTi with electron, Ne^+, Kr^+ and Xe^+. The critical temperature was found to increase monotonically with projectile mass from 185K for electron to 543K for Kr^+ and Xe^+. The kinetics of crystalline to amorphous transition was studied by measuring the integrated intensity of diffuse rings on electron diffraction patterns. The analysis of the results of this measurement by Gibbons model indicated that the direct amorphization occurs in a single damage zone with Kr^+, while overlapping of three damage zones is required for amorphization with Ne^+. In the light of these observations, the relation between the structure of irradiation damage and the crystalline to amorphous transition, and the projectile mass dependence of the critical temperature for irradiation-induced amorphization will be discussed. 14 refs., 5 figs.

15112 **(CONF-880841—24) An in situ HVEM study of the migration of bcc/glass interfaces in $TiCr_2$, induced by 1 MeV krypton irradiation at 80-180 K.** Allen, C.W.; Rehn, L.E. (Argonne National Lab., IL (USA)). Aug 1988. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004276/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

The Laves phase $TiCr_2$ is readily amorphized by 1 MeV Kr irradiation at temperatures below about 250 K. However, with continuing irradiation the glassy phase (a-$TiCr_2$) gradually transforms to a metastable bcc structure without measurable change of local composition. The results of direct observations of migrating a-$TiCr_2$/bcc interfaces at temperatures in the range 80-180 K yield an effective activation energy of 0.027 eV for the interface velocity. A model for this irradiation-induced phase transformation is discussed in terms of dynamic reconstruction within displacement cascades. The phenomenon has been termed 'cascade driven migration of structural interfaces.'

15113 **(CONF-881155—28) Compositional effects on processing and properties of nickel aluminides.** Sikka, V.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005133/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Compositional effects on hot and cold workability of ductile-ordered nickel aluminides are described. Compositional affects studied variation of chromium, aluminium, iron, and zirconium. The hot and cold workability of various nickel-aluminide alloys was ranked with respect to workability of stainless steel. The nickel-aluminide alloy containing chromium and low zirconium (IC-218LZr) had the best combination of hot and cold workability. This alloy also offered a good combination of strength and ductility values over a range of test temperatures. 3 refs., 8 figs., 1 tab.

15114 **(CONF-881155—36) Pyrolytic and laser photolytic growth of crystalline and amorphous germanium films from digermane (Ge_2H_6).** Eres, D.; Lowndes, D.H.; Tischler, J.Z.; Sharp, J.W.; Geohegan, D.B.; Pennycook, S.J. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006125/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

High-purity digermane (Ge_2H_6, 5% in He) has been used to grow epitaxially oriented crystalline Ge films by pyrolysis. Amorphous Ge:H films also have been deposited by pyrolysis and ArF (193 nm) laser-induced photolysis. The amorphous-to-crystalline transition and the film's morphology were studied as a function of deposition conditions. The film's microstructure, strain and epitaxial quality were assessed using x-ray diffraction curves and scanning and transmission electron microscopy. It was found that commensurate, coherently strained epitaxial Ge films could be grown pyrolytically on (100) GaAs at low (0.05-40 m Torr) Ge_2H_6 partial pressures for substrate temperatures above 380{degree}C.

15115 **(CONF-881155—40) Identification of cleavage planes in an Al_3Ti-base alloy by electron channeling in the SEM [scanning electron microscope].** George, E.P.; Porter, W.D.; Joy, D.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006133/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Selected area electron channeling patterns were used to identify the cleavage planes in a polycrystalline Al_3Ti-base alloy having the $L1_2$ structure. In order to do this unambiguously in the scanning microscope (SEM), one needs to know that the cleavage facet from which any given channeling pattern is obtained is indeed normal to the electron beam. We accomplished this by utilizing a recently-developed technique in which an optical microscope with a short depth of focus is inserted in the SEM column and used to measure the elevations of several points on the cleavage faces. By approximately tilting and rotating the simple, and using the optical microscope to measure elevations, it was possible to orient the facets normal to the beam. The cleavage planes in a cast and extruded alloy having an equiaxed grain structure were compared with those in a directionally-solidified (DS) alloy of the same composition. Of the eight cleavage facets examined in the DS material, six were of the {110} type and two were of the {111} type. Of the six facets examined in the cast and extruded material, two each were of the {110} and {111} types, and one each were of the {100} and {013} types, although it cannot be said that all possible cleavage planes have been identified in this alloy, the availability of several low-strength cleavage plane apparently exacerbates its brittleness. 14 refs., 2 figs., 2 tabs.

15116 **(CONF-890310—1) Near threshold fatigue curve based on the dislocation shielding model of fracture.** Chang, S.J.; Mura, T. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88011854/JAW.

From 7. international conference on fracture; Houston, TX, USA (20 Mar 1989).

Dislocation pileup along an inclined direction from a crack tip has been observed in metals during tensile deformation in an electron microscope. Dislocations are emitted from the crack tip, move through a dislocation-free zone and pile up in the plastic zone. The problem of inclined pileup of screw dislocations at a crack tip with a dislocation-free zone has been solved by applying the Wiener-Hopf method. Result can be used to calculate the crack tip blunting and the local stress intensity K for the applied stress intensity K_3. According to the fatigue theory of Laird, the crack propagation per cycle has the order of magnitude of the blunting. The blunting versus K_3 is then plotted. It has the shape of the near threshold fatigue curve. To plot this curve, the local stress intensity K has been assumed to be the critical value K/sub g/ for the dislocation emission at the crack tip. 19 refs., 3 figs.

15117 **(CONF-8805152—2) In-situ HVEM studies of the early stages of oxidation of nickel and nickel-chromium alloys.** Marikar, P.; Brodsky, M.B.; Sowers, C.H.; Zaluzec, N.J. (Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 24p. NTIS, PC A03 - OSTI. Order Number DE89005833/JAW.

From Electron microscopy of surfaces and interfaces; Oak Brook, IL, USA (16 May 1988).

In-site oxidation of nickel, nickel-5, and nickel-25 atomic percent chromium single crystals of <100> orientation was studied by electron diffraction and contrast experiments both in a high voltage electron microscopy environmental cell, and conventional 100 KeV transmission electron microscopes. Environmental cell studies were conducted at temperatures between 500 and 700{degree}C, and at oxygen partial pressures of 2.7 Pa and 2.4 kPa Torr for periods up to 90 minutes. The oxidation process was characterized using bright-field, dark-field imaging and selected area diffraction techniques, as well as x-ray energy dispersive and electron energy loss spectroscopy. Oxidation was observed to begin in within 40 seconds. Simultaneous nucleation of small NiO crystallites of 5 to 10 nm diameter, and growth of bright rectangular facets were observed, eventually resulting in non-uniform sample thickness. The epitaxial relationships were determined for Ni <100> and Ni-5 Cr <100>. These results and the conditions for the formation of Cr_2O_3 are discussed and compared with those for oxidation processes in bulk alloys. 20 refs., 8 figs., 1 tab.

15118 **(CONF-8809202—3) Irradiation-enhanced and -induced mass transport.** Rehn, L.E. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 34p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004202/JAW.

From Symposium on irradiation-enhanced materials science and engineering; Chicago, IL, USA (25 Sep 1988).

Irradiation can be used both to enhance diffusion, that is to increase the rate at which equilibrium is attained, as well as to induce nonequilibrium changes. The main factors influencing whether irradiation will drive a material toward or away from equilibrium are the initial specimen microstructure and geometry, the irradiation temperature, and the primary recoil spectrum. This paper summarizes known effects of irradiation temperature and primary recoil spectrum, on mass transport during irradiation. In comparison to either electron or heavy-ion irradiation, it is concluded that relatively low-energy, light-ion bombardment at intermediate temperatures, offers the greatest potential to enhance the rate at which equilibrium is attained. The greatest departures from equilibrium can be expected from irradiation with similar particles at very low temperatures. 45 refs., 8 figs.

15119 **(DOE/ER/13331—1) [Collaborative program of research in engineering sciences]: Progress report, January 1, 1988--December 31, 1988.** (Massachusetts Inst. of Tech., Cambridge (USA)). 1988. Contract FG02-85ER13331. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005897/JAW.

Research programs in the following areas are briefly described: High Temperatures Gas-Particle Reactions, heat flow and mass transfer in plasma systems; Multivariable Control of Gas Metal Arc Welding; Metal Transfer in Gas Metal Arc Welding; In-

Process Control of Residual Stresses and Distortion in Automatic Welding; Synthesis of Heat and Work Integration Systems for Chemical Process Plants; Parity Simulation of Dynamic Processes; Fracture Mechanics; Fracture in Pressure Vessels Alloys; and Stress and Fracture Analysis of Particles in Crushing Beds. Publications resulting from each program are listed. (CBS)

15120 **(DOE/ER/45215—5) Studies of alternative-crystallization-phase nucleation: Annual report.** Kelly, T.F.; Hitchon, W.N.G. (Wisconsin Univ., Madison (USA)). Feb 1989. Contract FG02-85ER45215. 3p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89007220/JAW.

Progress is supported of phase studies, with an emphasis on nucleation, in the following systems: nickel-chromium, iron-manganese, iron-cobalt, silicon, germanium, and liquid metals. 9 refs. (CBS)

15121 **(DOE/ER/45308—2) The role of composition and microstructure gradients on weld metal properties and behavior: Progress report, 1 January 1988--31 December 1988.** Matlock, D.K.; Olson, D.L. (Colorado School of Mines, Golden (USA). Center for Welding and Joining Research). Jan 1989. Contract FG02-87ER45308. 64p. (MT-CWR—089-029). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006789/JAW.

The effects of weld metal compositional and microstructural gradients on phase transformation, microstructural stability, and mechanical properties are considered from a fundamental basis in weld metal alloys which are primarily austenitic (e.g., stainless steels). Models which incorporate compositional gradients are developed to predict the resulting weld metal properties and behavior. The mechanical properties of weld metal are modeled based on composite theory in which individual weld metal zones are considered as discrete elements within a composite structure. 17 refs., 28 figs.

15122 **(DOE/ER/45310—16) Grain boundary kinetics: 2, In-situ observations of the role of grain boundary dislocations in high-angle boundary migration.** Babcock, S.E.; Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jan 1989. Contract FG02-87ER45310. 35p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006791/JAW.

The capillarity-induced motion of near-Σ5 grain boundaries in Au was directly observed and video-recorded by means of hot-stage in-situ transmission electron microscopy. The observed boundary motion differed from the boundary "displacement" caused by the stress-induced passage of secondary grain boundary dislocation (SGBD)-steps along the boundary which was studied in Part I of this work in the following respects. It occurred in a jerky fashion, no translation of one abutting crystal with respect to the other was observed, and quantitative evidence proved that SGBDs were not involved. These results ruled out the SGBD-Step Model for the observed motion which was identified as common long-range boundary migration. In-situ observations of the migration of more general high-angle boundaries in polycrystalline Al films revealed similar jerky motion and an apparent lack of any significant contribution to migration by observed SGBDs. 26 refs., 7 figs.

15123 **(DOE/ER/45354—T1) Corrosion fatigue of iron-chronium nickel alloys: Fracture mechanics and chemistry: Progress report, 1 June--31 December 1988.** Wei, R.P. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Mechanical Engineering and Mechanics). 27 Jan 1989. Contract FG02-88ER45354. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006985/JAW.

Principal efforts during 1 June to 31 December 1988 are as follows: (1) preparation and characterization of a high-purity heat of FeCrNi alloy; (2) critical assessment and further development of electrochemical techniques for measuring the kinetics of electrochemical reactions on stainless steel surfaces; and (3) characterizations of the crystallographic nature of fracture surfaces produced by aqueous corrosion fatigue in a 304 stainless steel (Fe18Cr9Ni alloy) to provide background information on embrittlement mechanisms and to explore various analytical techniques. Progress in each of the areas is briefly summarized in this report.

15124 **(EPRI-NP—6202) Material specification for alloy X-750 in LWR [light water reactor] internal components.** Stein, A.A.; Gennaro, M.S. (Electric Power Research Inst., Palo Alto, CA (USA); Stone and Webster Engineering Corp., Boston, MA (USA)). Jan 1989. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006842/JAW.

This report presents a review of the stress corrosion cracking behavior of alloy X-750, the alloy chemistry, metallurgy, and mechanical properties as well as an interim material specification developed from these data. The material specification addresses requirements for heat treating, metallurgy, mechanical tests, microstructure, and quality assurance to optimize the stress corrosion resistance of alloy X-750 in light water reactor environments. The specification can be used to effectively identify and screen stress corrosion cracking resistance material. A justification for these specification requirements also is included. This information will enable the utility industry to purchase alloy X-750 in a manner which optimizes its corrosion performance with no degradation of its other properties. 25 refs., 1 tab.

15125 **(EUR—11476) Performance of liquid Li-Pb alloys on air with insulating structure.** Kottowski, H.; Kuhlboersch, G.; Droste, D.; Dietz, H. (Commission of the European Communities, Ispra (IT). Joint Research Centre). (Commission of the European Communities, Luxembourg). 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88756438/JAW.

Tests were performed with Li and various Li-Pb alloys with respect to their behaviour in air and in combination with design materials of the fusion reactor at high temperature. The main aim was to study the behaviour of Li/sub 17/Pb/sub 83/ from the plant operation safety point of view. Repeating tests with Li/sub 17/Pb/sub 83/ and Li/sub 50/Pb/sub 50/ up to {similar←to} 450/sup 0/C in air and in combination with different materials for thermal insulation did not show visible reactions. At {similar←to} 800/sup 0/C, Li/sub 50/Pb/sub 50/ showed some slow reaction with quartz and magnesium-calcium-oxide base materials, whereas the reaction with Li/sub 17/Pb/sub 83/ is still negligible. As far as Li and Li/sub 7/Pb/sub 2/ are concerned, when heated above their melting point, moderate reactions were observed in stainless steel containers. However, the reaction became violent when Li/sub 7/Pb/sub 2/ came in contact with quartz or magnesium-calcium-oxide. The same reaction became very violent when only Li was involved. The reaction of Li and Li/sub 7/Pb/sub 2/ with the quartz and magnesium-calcium-oxide materials does not stop once ignited, even if protected in inert gas atmosphere (Li > 450/sup 0/C and Li/sub 7/Pb/sub 2/ > 850/sup 0/C).

15126 **(GKSS—86/E/63) Computer-aided test method for stress cracking corrosion tests.** Dietzel, W.; Balzereit, K.H.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofforschung). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 11p. (In German). (CONF-8611229—). GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.).

From Lecture and discussion meeting on materials testing, with posters; Bad Hauheim, F.R. Germany (27 Nov 1986).

The factors K/sub Iscc/ and da/dt=f(K), which characterize the stress crack corrosion of the system Al 2024 T 351 in a 3.5% NaCl solution, could be determined with the described test method in relatively short test period (about 3 months). This method also informs on the crack resistance curve of the specific material which is effective in stress crack corrosion. One disadvantage of the method lies in the relatively great experimental expenditure, which is necessary for the execution. (orig./IHOE).

15127 **(GKSS—86/E/64) Comparative studies for indirect measurement of crack lengths under vibrational load in a corrosive atmosphere.** Wellenkoetter, B.; Horstmann, M.; Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofforschung). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 12p. (In German). (CONF-8611229—). GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.).

From Lecture and discussion meeting on materials testing, with posters; Bad Hauheim, F.R. Germany (27 Nov 1986).

Because of the difficulty to measure the crack length in corrosive medium and also for the automation of the test execution, it is useful to employ indirect crack length measuring methods. In order to carry out computer-controlled tests - e.g. ΔK=const. - it is necessary to determine the crack length as exact as possible. Therefore, the results of the direct current potential method, the alternating current method, the compliance method are compared with each other and with the optically read crack length.

15128 **(GKSS—88/E/38) CTOD testing of HAZ and analysis of pop-in behaviour.** Kocak, M.; Chen, L.; Schwalbe, K.H.; Terlinde, G.; Gnirss, G. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Fuchs Metallwerke, Meinerzhagen (Germany, F.R.); Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)). 1988. 10p. (CONF-880205—). Reprint from: 7th International conference and exhibit on offshore mechanics and arctic engineering (OMAE). Vol. 3. Published by the American Society of Mechanical Engineers, New York (USA). Paper No. OMAE-88-978.

From 7. international offshore mechanics and Arctic engineering conference; Houston, TX, USA (7 Feb 1988).

HAZ CTOD tests were carried out on non-matching bead on plate SAW (submerged arc welding) weldments at room temperature. The effects of the notch position and weld metal matching on the HAZ toughness were studied by taking weld metals with three strength levels (austenitic, ferritic and martensitic weld metals). The notches were located parallel (L-Type) and perpendicular (T-Type) to the straight fusion line and across the bevelled fusion line (Cross-Bond-Type). The results indicate that the T-Type CTOD specimens may be used for screening the most brittle zone of the HAZ and may to a certain extent ease the experimental difficulties of the HAZ CTOD testing. The CTOD crack initiation (pop-in) values are controlled by the microstructure of the crack tip zone and the strength of the surrounding material. The recently proposed pop-in assessment procedure was used for the evaluation of the pop-ins and results were discussed in terms of the measurements of the load drop, crack extension and the CTOD jump values.

15129 (IA—1440, pp 136-137) **Influence of heat treatment at 1300/sup 0/C on the internal morphology of tantalum, tantalum-10 w/o tungsten and tungsten foils, and the additional effect of immersion in liquid uranium.** Kuznietz, M.; Livne, Z.; Cotler, C.; Erez, G. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15130 (IA—1440, pp 135) **Neutron irradiation effects in commercial-purity type A5 aluminium.** Munitz, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15131 (INIS-SU—65, pp 11-18) **Factor of dislocation preference to intrinsic interstitial atoms in metal.** Konobeev, Yu.V.; Strokova, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physic of radiation damage and radiation material technology. Scientific-technical collection.

Existing experimental data on the microstructure and swelling of pure nickel irradiated by host ions and strongly differing damaging dose rates are analyzed using analytical expressions for sink intensities of edge dislocations and pores obtained earlier with account of arbitrary strong vacancy recombination (VAC) and host interstitial atoms (HIA). Differing from other papers on void and dislocation sink efficiency for vacancy recombination was not supposed to equal one. The purpose of the paper is to determine temperature behaviour of the factor of dislocation preference to HIA by the experimental data. This behaviour is shown to be determined by growing with temperature ratio of radii of HIA, Li and VAC, Lv dislocation capture, but only with account of the contribution of bombarding ions to HIA generation rate it is possible to reach independence of this ratio from the dose rate. Taking into account this contribution the HIA, Gi generation rate exceeds the generation rate of monoVAC, Gv:Gi=Gv(1+a). For the found optimum value a=1.064x10/sup -3/ the calculated values of Li/Lv ratio for two dose rates differing 100 times in the 425-725 deg C temperature range are described by the unique curve of the form Li/Lv=1+524.54 exp(7303.2/T), where T- Kelvin temperature. Increase of Li/Lv with growth of T is associated with different functional dependence of energy of dislocation interaction with HIA and VAC on the distance of the latters from the dislocation line. 5 refs.; 3 figs.; 1 tab.

15132 (INIS-SU—65, pp 63-65) **Grain boundary role in thermal creep of austenitic stainless steel.** Safonov, V.A.; Tyumentsev, S.N.; Kaptel'tsev, A.M.; Nalesnik, V.M.; Averin, S.A.; Solonin, M.I. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physic of radiation damage and radiation material technology. Scientific-technical collection.

Studies on peculiarities of thermal creep and changes in the grain structure of austenitic stainless steel type 16-15 are carried out. Two ranges of steel thermal creep controlled by different mechanisms are shown to exist in the 400-700 deg C temperature range. Grain-boundary slip with high activation energy (Q>90 kcal/mole at T>650 deg C) and degree parameter in the force dependence of the creep rate (n=5 at T=600, 650 deg C) is the main creep mechanism in the high-temperature range. Diffusion creep is the main deformation mechanism at low temperatures. 4 refs.; 3 figs.; 1 tab.

15133 (INIS-SU—65, pp 3-10) **On the theory of precipitation growth in substitutional alloys under irradiation.** Bakaj, A.S.; Turkin, A.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

A system of equations describing kinetics of point defects and alloy components in a substitutional binary alloy under irradiation is obtained. The problem of diffusional growth of spherical precipitation of a new phase is considered, and analytical expressions for precipitation growth rate in different limiting cases are obtained. A kinetically equilibrium value of substitutional solid solution concentration is found. At the concentration of the solid solution below kinetically equilibrium one the solid solution appears radiation-resistant. At the given radiation dose rate and microstructure parameters the dependence of kinetically equilibrium concentration on temperature specifies the equilibrium curve for the solid solution and an extended new phase under irradiation. 9 refs.; 1 fig.

15134 (INIS-SU—65, pp 19-23) **New type of structural defects of large-angle grain boundaries and radiation-induced grain boundary slip.** Bereznyak, P.A.; Bojko, V.S.; Mikhajlovskij, I.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Experimental data testifying to existence of radiation-induced grain-boundary slip (GBS) are considered. The interpretation of a large-angle grain boundary (GB) as a two-dimensional crystal is suggested, and, thereby, possible existence of a new type of defects in large-angle GB called displanations is analyzed. Decrease of GB viscosity under polycrystal irradiation is interpreted as a phase transition in GB concerned with dissociation of displanation pairs generated by irradiation. 15 refs.; 1 fig.

15135 (INIS-SU—65, pp 24-28) **Light impurity effect on phase transitions in metals under irradiation.** Devyatko, Yu.N.; Rogozhkin, S.V.; Tronin, V.N. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Conditions for arising instability of homogeneous solution of point defects in irradiated metal containing different sinks are investigated. This instability results in phase transitions in irradiated metals such as formation of vacancy voids, loops, impurity bubbles. The substitution impurity is shown to play the determining role in occurrence of instability. Sinks present in real materials change the kinetics of achievement of the phase transition point, as a rule, decreasing the critical fluence of instability occurrence. 8 refs.; 1 fig.; 1 tab.

15136 (INIS-SU—65, pp 29-36) **Influence of stacking fault energy on radiation-induced processes in metals.** Khmelevskaya, V.S.; Malynkin, V.G.; Bykov, V.N.; Zheltov, Yu.V.; Ivanov, A.N. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physic of radiation damage and radiation material technology. Scientific-technical collection.

The idea of relation of stacking fault energy with parameters of radiation damage of materials is discussed. Data on void swelling in some metallic systems are compared in the paper with changes in stacking fault energy, and obvious correlation is traced. The results are presented for experiments carried out by the methods of structural analysis and by means of microhardness measurements, in which differences in damage of pure metals and solid solutions with different stacking fault energy under irradiation are found. Similar correlation are discovered for refractory metals with bcc- and hcp-structures (W, Mo, Ta, Nb, Zr, Ti), for iron-base solid solutions (Fe-Co, Fe-Ni and Fe-Mn) as well as for austenitic steels. 25 refs.; 3 figs.; 5 tabs.

15137 (INIS-SU—65, pp 37-50) **Phosphorus segregation effect on radiation hardening of reactor vessel steel.** Platonov, P.A.; Amaev, A.D.; Nikolaev, V.A.; Tursunov, I.E.; Levit, V.I.; Krasikov, E.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Investigation into reactor vessel pearlitic steel for disclosure of the possible mechanism of its radiation embrittlement are conducted. The analysis of electroresistance recovery of pearlitic steel irradiated at T/sub ran/>250 deg C makes it possible to state that steel irradiation is followed by grain-boundary phosphorus cluster formation. It is shown as a result of the experiment with a model material, that phosphorus cluster formation increases its tendency to hydrogen embrittlement. In this case the following changes take place in the steel with a certain level of phosphorus segregation under the effect of hydrogen: stable defects as cracks appear without application of external stress; incomplete reversibility of steel properties exists; steel fracture becomes brittle intercrystalline with a low level of true fracture stress. 30 refs.; 17 figs.; 2 tabs.

15138 (INIS-SU—65, pp 51-52) **Influence of helium implantation technique on molybdenum radiation hardening.** Ibragimov, Sh.Sh.; Reutov, V.F.; Loktionov, A.A.; Vagin, S.P. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Experimental results of studying radiation hardening of helium-implanted molybdenum in the 10/sup -5/-10/sup -2/ at.% concentration range are presented. Helium implantation into the material was exercised in a cyclotron by three different methods differing by the quantity ratio of displaced atoms to helium concentration and "hardness" of spectra of preliminary knocked-out atoms (PKA). The degree of radiation hardening is shown to essentially depend on the technique of molybdenum cyclotron alloying, and it is not determined only by implanted helium concentration and level of vulnerability to damage but difference in PKA spectra. 3 refs.; 1 fig.

15139 (INIS-SU—65, pp 53-57) **Helium content effect on heat resistance of high-nickel alloy 03Kh20N45M4BCh under irradiation.** Kiselevskij, V.N.; Kovalev, V.V.; Kovyrshin, V.G.; Krasil'nikov, V.S. (AN Ukrainskoj SSR, Kiev. Inst. Problem Prochnosti; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij; AN SSSR, Khabarovsk. Kompleksnyj Nauchno-Issledovatel'skij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Heat-resistance of 03KH20N45M4BCh alloy at 923 K under reactor radiation after helium and hydrogen ion irradiation in the 3x10/sup 22/-2x10/sup 24/ ion/m/sup 2/ dose range are investigated. Investigations into kinetics of helium thermal sorption releasing at specimen heating up to 1273 K at constant velocities of 0.1-0.4 deg Cxs/sup -1/ are carried out. Based on data on gas release it is concluded that the most part of diffusion-mobile helium after implantation is in the surface layer not more than 5 μm, and concentration in it is not less than 10/sup -2/ at.%. The results obtained in the given paper on durability and creep show that long-term strength of the specimens preliminarily irradiated with helium ions is by 30-40 mPa lower than that in the initial state. 4 refs.; 6 figs.; 1 tab.

15140 (INIS-SU—65, pp 58-59) **Influence of grain boundary state on thermal and radiation creep in austenitic stainless steel type 16-15.** Tyumentsev, S.N.; Safonov, V.A.; Nalesnik, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Regularities of thermal creep (TC) in the 400-650 deg C temperature range and radiation-induced creep (RC) at 350 deg C of specimens of three batches of austenitic steel type 16-15 produced by different technologies are investigated. It is shown that change in melting and heat treatment technologies of specimen material results in intensification or suppression of processes controlling TC and RC via change in grain boundary state. 1 ref.; 1 fig.; 1 tab.

15141 (INIS-SU—65, pp 66-71) **Change of palladium surface structure under irradiation in low voltage two-component hydrogen containing plasma.** Radzhabov, T.D.; Alimova, L.Ya.; Kulagina, L.V.; Sharudo, A.V. (AN Uzbekskoj SSR, Tashkent. Inst. Ehlektroniki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Change in palladium surface structure under the effect of low-voltage (U/sub max/=500 V) two-component hydrogen containing glow-discharge plasma depending on the chemical nature of the impurity, its concentration in hydrogen plasma, discharge parameters, radiation dose and treatment technique are investigated experimentally. Development of the relief on the surface in the studied 10/sup 18/-10/sup 21/ ion/cm/sup 2/ radiation dose range is shown to depend on plasma composition and to essentially differ from single-component plasma irradiation. Formation of chemical compounds is observed under irradiation in complex plasma on the surface alongside with defect formation. Correlation between the value of hydrogen permeability and change in the structure of Pd-membrane surface is analyzed. 20 refs.; 3 figs.

15142 (INIS-SU—65, pp 72-73) **On thermal stresses in materials specimens under pulsed electron beam irradiation.** Blazhevich, S.V.; Stratienko, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Linear dependence of the amplitude of an acoustic signal excited in a specimen representing a thin rod by a pulsed accelerated electron beam on current amplitude under the condition tau/sub pul/>d/s/sub e/, where tau/sub pul/- duration of accelerator message; d- characteristic dimension of the interaction range; s/sub e/- sound velocity in a specimen, is shown experimentally, taking nickel specimens as an example. 3 refs.; 1 fig.

15143 (INIS-SU—65, pp 60-62) **Grain boundary effects of radiation-induced creep in austenitic stainless steel.** Safonov, V.A.; Tyumentsev, S.N.; Averin, S.A.; Nalesnik, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physics of radiation damage and radiation material technology. Scientific-technical collection.

Changes in grain structure occurring under radiation creep (RC) of austenitic stainless steel type 16-15 in the 30-650 deg C temperature range under stresses of 100-800 MPa were investigated. Radiation-induced diffusion creep of Koble type is shown to be the dominating mechanism of plastic deformation under these conditions. In the range of high temperature (650 deg C) and stresses ($\sigma > = \sigma$/sub 0.2/) steel RC is realized, mainly, due to grain-boundary slip, that is marked by experimentally fixed intense turn of grains relatively to one another with grain boundary migration at conservation of their uniaxial character. 6 refs.; 5 figs.

15144 **(INIS-SU—65) Phyiscs of radiation damage and radiation material technology. Scientific-technical collection.** (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1988. 87p. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; No. 1(43).

Individual papers are processed separately for the data base. (DLC)

15145 (INIS-SU—68, pp 528) **Moessbauer study of radiation and oxidation effects on Fe-Mn alloy structure.** Binnatov, K.G.; Mekhrabov, A.O.; Shukyurov, T.A.; Isfandiyarov, G.G.; Aliev, S.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15146 **(IPEN-PUB—195) Qualitative texture investigation of a maraging steel sample by neutron diffraction technique.** Pugliesi, R.; Yamazaki, I.M. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705543/JAW.

By means of the neutron diffraction technique the texture of a maraging steel rolled sheet have been determined. The measurements were performed by using a neutron diffractometer installed at the IEA-PI Nuclear Research Reactor, in the beam-hole n/sup 0/ 6. To avoid corrections such as neutron absorption and sample luminosity the geometric form of the sample was approximated to spheric and its dimensions do not exceed that of neutron beam. The texture of the sample was analysed with help of a computer programm that analyses the intensity of the diffracted neutron beam and plot the pole figure.

15147 **(LA-UR—88-3167) A stereological analysis of ductile fracture by microvoid coalescence.** Steele, J.H., Jr. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 24p. (CONF-890310—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000355/JAW.

From 7. international conference on fracture; Houston, TX, USA (20 Mar 1989).

A stereological analysis for ductile fracture by microvoid coalescence is presented based upon the model of Widgery and Knott which postulates that microvoids link with a propagating crack if they lie within a certain interaction distance of its plane. A 3- dimensional analytical expression for dimple density and shape is developed from this model using projected image relationships for a thin slab. Void nucleation and growth are incorporated into the analysis using numerical integration of the Rice-Tracey growth equation over the appropriate strain range. An evaluation of the stereological approach is given using tensile data from a spheroidized 1045 steel to predict the effect of hydrostatic pressure upon the dimple density. The analysis, which is consistent with observed correlations between dimple density and second phase particle density, is shown to provide an estimate of dimple size and microroughness parameter used in local stain models for microvoid coalescence. 24 refs., 10 figs.

15148 **(LA-UR—88-3723) Electrodeposition of aluminium, aluminium/magnesium alloys, and magnesium from organometallic electrolytes.** Mayer, A. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 11p. (CONF-890343—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003483/JAW.

From 1. international congress on high-tech-materials and finishing; Berlin, F.R. Germany (12 Mar 1989).

The electrodeposition of aluminum, magnesium, and the combination of these metals from nonaqueous media is discussed. Plating baths for depositing Al/Mg alloys or for plating essentially pure Mg were developed. These solutions contain alkali meal fluoride or quaternary ammonium halide/aluminium alkyl complexes and dialkyl magnesium dissolved in aromatic hydrocarbons. Alloy deposits over the whole composition range can be plated from these solutions by varying the relative quantities of the aluminium and magnesium alkyls and by changing the bath-operating parameters. 18 refs., 4 figs.

15149 **(LA-UR—88-4213) Analysis of the strain-rate sensitivity at high strain rates in FCC and BCC metals.** Follansbee, P.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 15p. (CONF-890324—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005471/JAW.

From 4. international conference on mechanical properties of materials at high rates of strain; Oxford, UK (20 Mar 1989).

The development of a constitutive model based on the use of internal state variables and phenomenological models describing glide kinetics is reviewed. Application of the model to the deformation of fcc metals and alloys is illustrated, with an emphasis on the behavior at high strain rates. Preliminary results in pure iron and

4340 steel are also presented. Deformation twinning is observed in iron samples deformed in the Hopkinson pressure bar. The influence of twinning on the proposed constitutive is discussed. 11 refs., 8 figs.

15150 **(LA-UR—88-4236) Damage to silver coatings from high average power 1-μm laser.** Sanders, V.; Jolin, L.J.; Salazar, S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-8810284—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005476/JAW.

From Laser induced damage in optical materials; Boulder, CO, USA (26 Oct 1988).

Optical coatings are being developed for use in high average power, pseudo continuous wave, 1-μm lasers. In particular, the subject of this study is a silver coating to be applied to a cooled substrate for use in a radio frequency-free electron laser (rf-FEL). Damage threshold measurements and finite element calculations were made that demonstrate the pure thermal nature of heating, and eventual damage, rf-FEL pulse format. 4 figs., 1 tabs.

15151 **(LA-UR—89-218) Theoretical studies of Ni_3Al and NiAl with impurities.** Chen, S.P.; Voter, A.F.; Boring, A.M.; Albers, R.C.; Hay, P.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-881155—42). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006556/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Intermetallic compound has been extensively studied because of their superior properties in strength, low creep rate, and high melting point. But most of the systems have room temperature ductility problems, like $L1_2$ and B2 compounds. Both $L1_2$ Ni_3Al and B2 NiAl exhibit intergranular fracture mode. Understanding grain boundaries in these materials is of particular importance since intergranular fracture limits the applicability of these otherwise promising material. In an effort trying to understand the fracture mechanism, we have used embedded atom potentials to study the properties of Ni_3Al and NiAl. We also consider the effect of boron, sulfur, and nickel segregation on the strength of grain boundaries in Ni_3Al and NiAl. 22 refs., 2 figs.

15152 **(LBL—25323) Scanning tunneling microscopy of metals on graphite.** Ganz, E.D. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 193p. NTIS, PC A10/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006608/JAW.

The use of scanning tunneling microscopy of gold and thin copper films on graphite is described. Discussions of the equipment, modifications of a gold surface, deformation of a graphite surface image interpretations, imaging of metal clusters on graphite in air and UHV, imaging of small two dimensional and three dimensional islands on graphite, and dynamics are included. 173 refs., 89 figs., (CBS)

15153 **(LBL—26283) Exploratory alloy development in the system Al-Sc-X.** Sawtell, R.R. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 88p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007088/JAW.

The goal of this work has been to improve the cost/performance balance in Al-Sc-X alloys by optimizing the precipitation hardening component of strengthening in these alloys. The approach involved selecting ternary additions that would interact with Sc in the $L1_2$ phase precipitates known to form in Al-Sc alloys, modifying the precipitates and increasing overall precipitate volume fraction. The rare earth (RE) elements were chosen as candidates because of their chemical similarity to Sc. Stabilities of various phases in the Al-RE and Al-Sc-RE systems were considered with emphasis on conditions favorable to formation of the $L1_2Al_3(Sc,RE)$ phase. The thermodynamics of precipitation of this phase in an Al matrix was then considered. Having established the likelihood of interaction of various RE in $L1_2$ precipitates attention was turned to effects of these variations in precipitate character on relative strengthening efficiency. The precipitates become more effective obstacles as size of the RE addition increases. An experimental program was developed to investigate effects of RE size at a constant level of alloying on the trade-off between effects of greater precipitate strengthening efficiency provided by larger RE and the accompanying reduction in degree of substitution and, thus, volume fraction. 58 refs., 46 figs., 23 tabs.

15154 **(LBL—26334) Microstructural and magnetic characterization in soft magnetic Fe-Si-Al (Sendust) alloy.** Kim, J.D. (Lawrence Berkeley Lab., CA (USA)). Dec 1988. Contract AC03-76SF00098. 112p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007130/JAW.

Microstructure and its effect on magnetic domain structure and domain wall motion has been studied to understand the role of microstructure in determining the magnetic properties of a soft magnetic Sendust alloy. Electron microscopy of dark field imaging utilizing superlattice reflections has been mainly used to investigate the ordering behavior and corresponding microstructural changes, and Lorentz electron microscopy allowed the effect of microstructure on magnetic domain structure and wall motion to be observed. Antiphase boundaries (APBs) and other imperfections have been shown clearly and simultaneously with the observation of magnetic domain walls, even with the objective lens off. 101 refs., 35 figs., 3 tabs.

15155 (N—89-12626, pp 134-171) **Constitutive behavior of single crystal PWA 1480 and directionally solidified MAR-M 246 under monotonic and cyclic loads at high and low temperature.** Milligan, W.W.; Huron, E.S.; Antolovich, S.D. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Strain rate, temperature, time, and microstructure had strong effects on the mechanical properties of Directionally Solidified MAR-M 246 + Hf and PWA 1480, and physical damage. This is the first step toward characterizing the constitutive behavior of the alloys from the physical point of view. In the remaining portion of the program, these relationships will be further explored, in hopes of developing constitutive models which will be based on actual microstructural deformation mechanisms in the alloys.

15156 (N—89-12626, pp 172-204) **High-temperature LCF of Ni-201 and 304L stainless steel.** Halford, G.R.; Johnson, L.R.; Brown, J.A. (Aerojet TechSystems Co., Sacramento, CA (USA)). Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The high-temperature, low-cycle fatigue characteristics were investigated for two candidate alloys for use in the nozzle of an advanced design Orbital Maneuverable System (OMS) engine. Strain-controlled, low-cycle, creep-fatigue tests were performed in air on a commercially pure nickel (Ni2O1) at 483, 594, and 760 C, and on AISI Type 304L stainless steel at 650, 760, and 870 C. Both continuous strain-cycling tests and compressive-strain, hold-time tests were used in the evaluation. Direct comparisons are made between the two materials, and recommendations are presented as to which material offers the greatest potential for use.

15157 (N—89-12626, pp 580-617) **Effects of oxygen/hydrogen combustion chamber environment on copper alloys.** Murphy, M.; Anderson, R.E.; Rousar, D.C.; Vankleeck, J.A. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Main chamber liner deterioration in the Space Shuttle Main Engine (SSME) is sufficient to cause local chamber wall failures in the form of cracks through the copper alloy chamber wall. This deterioration is termed blanching and is characterized by an increase in local wall roughness and a bright, shiny, new penny type appearance. One of the objectives is to develop an understanding of the blanching phenomenon. The specific scope of this program in-

cludes: thermochemical analysis of the copper-oxygen-hydrogen system; thermogravimetric analysis (TGA) oxidation tests of NARloy-Z copper samples; metallurgical analyses of samples from 40K and full-scale SSME chamber liners, and TGA surface study tests under oxidation-reduction conditions with NARloy-Z, NARloy-A, OFHC, and zirconium copper alloys.

15158 (N—89-12626, pp 618-634) **Hydrogen-environment embrittlement and its control in high pressure hydrogen/oxygen rocket engines.** Chandler, W.T. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The workshop on hydrogen environment embrittlement was organized to examine in some detail the effects on metallic materials of the hydrogen environments encountered in high pressure hydrogen/oxygen rocket engines and to discuss methods of preventing hydrogen environment induced failures under such exposure conditions. The Space Shuttle Main Engine (SSME) is the most advanced high pressure hydrogen/oxygen rocket engine currently in service. To serve as a basis for the discussions to follow, the conditions under which materials are exposed to hydrogen environments in the SSME will be outlined and methods used in the design of the SSME to prevent hydrogen environment induced failures will be described. Data generated at Rocketdyne on the effects of high pressure hydrogen on properties of metallic materials will be presented.

15159 (N—89-12626, pp 635-659) **Multispecimen test facility for high-pressure hydrogen creep studies.** Verma, S.K. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The IITRI-developed equipment for creep rupture evaluation of materials in hydrogen at up to 20.7 MPa and 925 C is described. This facility can test six specimens simultaneously within a single vessel with continuous measurement of specimen extension within the vessel. A double-wall vessel design concept with balanced pressure across the inner wall was adopted successfully. All temperature and strain measurements are transmitted to a data logger for storage and analysis. Typical rupture life, minimum creep rate, and time to 1 percent strain for selected alloys are presented, as well as analysis using Orowan-Sherby-Dorn temperature-compensated technique to estimate 3500 h rupture life and stress to obtain 1 percent strain in 3500 h.

15160 (N—89-12626, pp 672-697) **Development of a computer-controlled technique to determine crack growth rate properties in controlled environments using crack opening displacement.** Moore, D.; Drinan, D.; Hodo, J. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

A computer-controlled testing technique was developed that utilizes crack opening displacement to predict crack lengths for compact tension specimens in crack growth rates (da/dN versus delta K) determinations. The crack growth rate data generated by the developed technique was compared statistically to data results of a highly reliable optical method. No significant difference could be determined between the data generated by either method. The computer-controlled method did prove, however, to be a reliable and cost effective method of determining crack growth rate data and can be incorporated in controlled environment crack growth rate determinations.

15161 (N—89-12626, pp 698-714) **Hydrogen effects on the fatigue and tensile behavior of CMSX-2 nickel base superalloy single crystals.** Bernstein, I.M.; Walston, S.; Dollar, M.; Domnanovich, A.; Kromp, W. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

A number of studies have suggested that specific nickel-based superalloy single crystal materials can be susceptible to varying degrees of hydrogen embrittlement under a variety of testing conditions in gaseous high pressure hydrogen, an important environment, for example, for space shuttle main engine turbopumps. Three areas will be stressed: extension of the low cycle fatigue tests to a lower plastic strain range and to hydrogen conditions produced by high pressure thermal charging; a more detailed fractographic study to ascertain the hydrogen induced fracture plane; and an enhanced solutionizing treatment to break up the dendritic macrostructure and an evaluation of how this thermal processing change affects hydrogen compatibility.

15162 (N—89-12626, pp 715-726) **Determination of mobile hydrogen in aerospace engine alloys.** Danford, M.D. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Hydrogen desorption data (coulombs desorbed vs. time) were obtained for Waspaloy and Rene' 41 using electrochemical methods. A more general method of analysis, using diffusion theory, was developed and applied. The method may assume an initial hydrogen distribution which conforms to that predicted by diffusion theory or a uniform initial distribution. The data are interpreted in terms of either of these initial distributions or a combination thereof. It was found that the initial hydrogen distribution for Waspaloy and Rene' 41, after both electrolytic charging and charging at 5000 psi hydrogen pressure, conformed closely to those predicted by diffusion theory. The hydrogen desorption is completely explained by the nature of the initial hydrogen distribution in the metal, which was previously assumed to be uniform, and the fast hydrogen is not due to surface and subsurface hydride formation, as was previously supposed. Finally, the hydrogen solubilities in the metals, for electrolytically charged samples, depend strongly on the charging rate and are about the same for Rene' 41 and Waspaloy.

15163 (N—89-12626, pp 727-748) **LCF and crack growth rate of turbine blade alloys in hydrogen and hydrogen/steam environments.** Cowles, B.A.; Deluca, D.P.; Warren, J.R.; Haake, F.K. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The low cycle fatigue (LCF) and fatigue crack growth testing of MAR-M246+Hf and PWA 1480 in high pressure hydrogen and hydrogen enriched steam at elevated temperatures are described. The PWA 1480 single crystal exhibited the best properties overall, compared to both single crystal and directionally solidified MAR-M246+Hf. Addition of water vapor to the hydrogen atmosphere caused more pronounced reduction in the properties of the directionally solidified material than in the single crystal.

15164 (N—89-12626, pp 749-757) **Development of a hydrogen resistant alloy.** Mcpherson, W.B. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

In the continuous search for hydrogen tolerant alloys, the latest evaluation of various compositions of the Fe-Ni-Co-Cr system with elemental additions of Cb, Ti, and Al is described. After processing, notched tensile specimens were tested in 34.5 MPa (5000 psi) hydrogen at room temperature as the main screening test. The H2/air ratio was used as the selection/rejection criteria. Several compositions approach the objective strength, 1241 MPa (180 ksi) ultimate and 1103 MPa (160 ksi) yield, with little or no degradation in hydrogen.

15165 (N—89-12717) **Influence of alloying elements on the oxidation behavior of $NbAl_3$.** Hebsur, M.G.; Stephens, J.R.; Smialek, J.L.; Barrett, C.A.; Fox, D.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1988. 14p. (NASA-TM—101398; E—4275; NAS—1.15:101398; CONF-8809190—). NTIS, PC A03/MF A01.

From Workshop on the oxidation of high-temperature intermetallics; Cleveland, OH, USA (20 Sep 1988).

NbAL3 is one candidate material for advanced aeropropulsion systems because of its high melting point, low density, and good oxidation resistance. Although NbAl3 has the lowest oxidation rate among the binary Nb-Al alloys, it does not form exclusive layers of protective Al2O3 scales. Recently Perkin et al., have shown the feasibility of forming alumina scales on Nb-Al alloys at greatly reduced Al contents. However, the objective was to maintain the high Al content, and hence low density, while achieving the capability of growing protective alumina scales. Alloy development followed approaches similar to those used successfully for superalloys and oxidation resistant MCrAlY coatings. Among the three elements examined (Ti, Si, and Cr) as ternary additions to Nb-Al3, Cr was the most effective in favoring the selective oxidation of Al. Nb-41Al-8Cr formed exclusive layers of alumina and had a k sub p value of 0.22 mg squared/cm (sup 4)/hr at 1200 C. The addition of 1 wt percent Y to this alloy was also beneficial, resulting in nearly an order of magnitude decrease in K sub p at 1200 C. Further improvements were achieved by adding about 1 wt percent Si to the quaternary alloy. The k sub p value of 0.012 mg squared/cm (sup 4)/hr for Nb-40Al-8Cr-1Y-1Si at 1200 C was identical to the best NiAl + Zr alloys. These NbAl3 alloys also exhibited excellent cyclic oxidation resistance for 100 hr at 1200 C, being nearly equivalent to NiAl + Zr.

15166 (N—89-12876, pp 33-43) **Fatigue and fracture overview.** Halford, G.R. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The accomplishments achieved under the isotropic creep-fatigue crack initiation life prediction program are summarized. A sizeable creep-fatigue crack initiation data base was generated on the nickel-base superalloy, B-1900. Companion constitutive modeling programs have also generated extensive data bases on the same heat of material. The crack initiation results have formed the basis of a new approach to creep-fatigue life prediction. The term Cyclic Damage Accumulation (CDA) was coined for the method, which was evaluated under isothermal, uniaxial conditions. Stringent laboratory verification experiments were used to test the accuracy of the method. Considering the quite limited material property data needed to evaluate the constants in the approach, the prediction accuracy is acceptable. At the expense of the larger data base required, Lewis developed total strain- strainrange partitioning method (TS-SRP) is capable of a higher degree of accuracy.

15167 (N—89-12876, pp 293-305) **Thermomechanical characterization of Hastelloy-X under uniaxial cyclic loading.** Ellis, J.R.; Bartolotta, P.A.; Allen, G.P.; Robinson, D.N. (Akron Univ., OH (USA)). Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

In most high-temperature engineering applications, components are subjected to complex combinations of thermal and mechanical loading during service. A number of viscoplastic constitutive models were proposed which potentially can provide mathematical descriptions of material response under such conditions. Implementation of these models into large finite element codes such as MARC has already resulted in much improved inelastic analysis capability for hot-section aircraft engine components. However, a number of questions remain regarding the validity of methods adopted in characterizing these constitutive models for particular high-temperature materials. One area of concern is that the majority of experimental data available for this purpose are determined under isothermal conditions. This is in contrast to service conditions which, as noted above, almost always involve some form of thermal cycling. The obvious question arises as to whether a constitutive model characterized using an isothermal data base can adequately predict material response under thermomechanical conditions. An experimental program was initiated within the HOST program to address this particular concern. The results of the most recent isothermal and thermomechanical experiments are described.

15168 (N—89-12876, pp 335-339) **Constitutive modelling of single crystal and directionally solidified superalloys.** Jordan, E.H.; Walker, K.P. (Engineering Science Software, Inc., Smithfield, RI (USA)). Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The trend towards improved engine efficiency and durability places increasing demands on materials that operate in the hot section of the gas turbine engine. These demands are being met by new coatings and materials such as single crystal and directionally solidified nickel-base superalloys which have greater creep/fatigue resistance at elevated temperatures and reduced susceptibility to grain boundary creep, corrosion and oxidation than conventionally cast alloys. Work carried out as part of a research program aimed at the development of constitutive equations to describe the elevated temperature stress-strain-time behavior of single crystal and directionally solidified turbine blade superalloys is discussed. The program involves both development of suitable constitutive models and their verification through elevated temperature tension-torsion testing of single crystals of PWA 1480.

15169 (N—89-12876, pp 385-397) **Life prediction and constitutive models for engine hot section.** Swanson, G.A.; Meyer, T.G.; Nissley, D.M. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The purpose of this program is to develop life prediction models for coated anisotropic materials used in gas turbine airfoils. In the program, two single crystal alloys and two coatings are being tested. These include PWA 1480, Alloy 185, overlay coating (PWA 286), and aluminide coating (PWA 273). Constitutive models are also being developed for these materials to predict the time independent (plastic) and time dependent (creep) strain histories of the materials in the lab tests and for actual design conditions. This nonlinear material behavior is particularly important for high temperature gas turbine applications and is basic to any life prediction system. Some of the accomplishments of the program are highlighted.

15170 (NP—9770219) **Susceptibility of austenitic CrNi-steels to corrosion and stress corrosion cracking under static and dynamic conditions in the system H/sub 2/O/NH/sub 3//CO/sub 2//H/sub 2/S/HCN. Preliminary final report.** Schmitt, G. (Bochum Univ. (Germany, F.R.). Technische Chemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 30 Jun 1988. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770219/JAW.

As part of the joint project 'gas water corrosion' the corrosion performance of austenitic CrNi steels was studied in the system H/sub 2/O/NH/sub 3//CO/sub 2//H/sub 2/S/HCN with the intention to evaluate limits of application. This knowledge is needed for repair of corrosion damages and for planning of new treating facilities in the coal and oil industry. In autoclave experiments with rotated coupons hydrogen cyanide proved to be responsible for the high aggressiveness of the 5-components system. The corrosion resistance of the austentic steels under investigation increases in the series $1.4541 < 1.4571 < 1.4439 < 1.4505 < < 1.4465$. GC-online analysis revealed that under experimental and process conditions (temp. up to 110/sup 0/C and pressures up to 5 bar) HCN is hydrolyzed to ammonium formiate supported by the catalytic action of corroding surfaces. Ammonium formiate showed no influence on the corrosivity of the system. Formation of thiocyanate can be totally excluded under extreme anaerobic conditions. (orig./MM) With 28 refs., 5 tabs., 19 figs.

15171 **(NRCN—596) Influence of heat treatment at 1300/sup 0/C on the internal morphology of tantalum, tantalum - 10 w/o tungsten and tungsten foils and the additional effect of immersion in liquid uranium.** Kuznietz, M.; Livne, Z.; Cotler, C.; Erez, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Jun 1988. 26p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705389/JAW.

The internal morphology of 0.3-mm-thick foils of tantalum, tantalum 10 w/o tungsten and tungsten is investigated by optical microscopy and a scanning electron microscope capable of microanalysis by EDAX. Comparison is made between foils: as-received, heat-treated at 1300/sup 0/C for 20 hours (for tantalum also for 40 hours), and after reaction and immersion in liquid uranium for 20 hours at 1300/sup 0/C. The heat treatment does not influence the internal morphology (grain size) in tantalum and tantalum - 10 w/o tungsten, and the multilayer structure of these foils following the immersion experiments is solely due to the effect of liquid uranium. This effect depends on prior annealing. In tungsten the heat treatment changes the dominant flow-line character of the foil into a grain structure, and the foil structure following the immersion experiment is due to the combined effect of heat-treatment and uranium penetration.

15172 **(UCID—21610-88) First semi-annual progress report on development of superplastic steel processing: A joint R and D effort between industry and a national laboratory: Caterpillar Inc., Peoria, IL; Ladish Co., Inc., Cudahy, WI; North Star Steel Company, Monroe, MI; Lawrence Livermore National Laboratory, Livermore, CA.** (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1988. Contract W-7405-ENG-48. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006469/JAW.

The influence of aluminum content and thermomechanical processing steps in developing fine microstructures in ultrahigh carbon steels (UHCS) was examined. It was shown that ultrafine pearlitic structures, containing no proeutectoid carbide networks, can be obtained by the addition of at least 1.5% aluminum. Hot-working (HW) followed by slow cooling from the austenite region (above A/sub cm/) will lead to a carbide-network-free pearlitic structure. Spheroidized structures, with the elimination of any pre-existing carbide networks, can be obtained either by a thermomechanical treatment or by a thermal treatment alone. These are: (1) warm working (WW) involving a divorced-eutectoid transformation with associated deformation (DETWAD), and (2) heat treating involving a divorced-eutectoid transformation (DET), which requires heating to a low austenitizing temperature followed by isothermal transformation just below the A_1 temperature. This retardation will provide a wide window of time and temperature for processing with a number of possible combinations of DET and DETWAD steps. Results of superplasticity studies on the UHCS-Al alloys reveal that superplastic behavior is enhanced by aluminum additions and by increasing the amount of deformation during DETWAD processing. Preliminary studies on the cold-rolling characteristics of the UHCS-1.6Al alloy reveal that it can be cold-rolled to 50% in the fully pearlitic condition without annealing, and to over 60% in the fully spheroidized condition. A modified Fe-C diagram is proposed for the UHCS-1.6Al. Aluminum is shown to raise the liquidus and solidus temperatures, to increase the solubility of carbon in austenite, to increase the A_1 temperature, and to introduce a three-phase region of ferrite, austenitic, and carbide.

15173 **(UCID—21614) Finite element modeling of a hydroformed sheet metal cover.** Maker, B.N. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006798/JAW.

This report summarizes an effort to model numerically the hydroform production of a sheet metal cover. After reviewing the initial drawings specifying the part, process engineers at Allied-Signal Kansas City assigned it a low feasibility index, indicating the part would be difficult to manufacture. At their request, this work was performed. Potential benefits included expediting production by minimizing the trial and error effort to determine forming parameters, i.e., blank size, pressure, and lubricant condition. These parameters could be in theory, determined from the computer model. It was noted at the start of the study that little lead time was available, and the computer results may not be available soon enough to assist process development. In this case, the benefit of increasing in-house analysis capability for use on future projects was seen as sufficient justification of this work. As this indeed became the case, this report is intended to include detailed notes on the construction and execution of the finite element model, in the hope that it may serve as a guide for future analysis. 5 refs., 7 figs., 2 tabs.

15174 **(UJV—8163-M) Localization of deformation and fracture of zirconium alloys.** Novak, J.; Lauerova, D. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). May 1988. 29p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705599/JAW.

The report consists of two parts. The first explains the theory of the localization of deformation in deformation zones and the theory of localized necking of thin sheets and their relation to the localization of damage and development of cracks. Part two deals with the qualitative and quantitative analysis of the behavior of Zr alloys. A bifurcation analysis is used for three variant constitutive equations to verify the hypothesis that predicted values of critical deformation in a corrosive medium represent deformations to fracture. The relation is defined between fracture toughness in a corrosive medium and critical deformation for the localization of deformation in deformation zones. The analysis of the processes of corrosion cracking of cladding tubes which had been without defects in the initial state, and of the development of cracks in the corrosive medium during planar deformation showed that there exists a close relation between mechanical characteristics and the development and growth of cracks. (author). 7 figs., 50 refs.

15175 (ZfK—584, pp 69) **Texture development in pass-rolling of fcc metals.** Klimanek, P.; Cyrener, K.; Muecklich, A.; Scholz, U. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15176 (ZfK—584, pp 70) **Texture development during cold rolling of (α + β)-brass.** Klimanek, P.; Kuehl, A.; Muecklich, A.; Scholz, U. (Bergakademie, Freiberg (German Democratic Republic). Sektion Metallurgie und Werkstofftechnik; Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15177 **Defect-ordered phases in a multiphase Cu-In-Se material.** Tseng, B.H.; Wert, C.A. (Department of Materials Science and Engineering and the Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Applied Physics;* **65**: No. 6, 2254-2257(15 Mar 1989).

Several copper-deficient phases in a Cu-In-Se ingot were identified and characterized by electron diffraction and energy dispersive x-ray analysis. Some were phases already identified by x ray and electron diffraction. A new vacancy-ordered phase with composition close to Cu/sub 0.75/In/sub 2.25/Se_4 was identified to have a thiogallate-type structure. A phase with composition close to $CuIn_5Se_8$ exhibited a polytype structure with both 7- and 14-layer stacking sequences.

15178 **On the thermodynamical driving force during ion mixing of the Co-Si system.** Xia, W.; Hewett, C.A.; Fernandes, M.; Lau, S.S.; Poker, D.B. (Department of Electrical and Computer Engineering, R-007, University of California, San Diego, La Jolla, California 92093). *Journal of Applied Physics;* **65**: No. 6, 2300-2306(15 Mar 1989).

The relative importance between the thermodynamical driving force and kinetics in thermal annealing and ion mixing in the thermally activated regime has not been clarified. To probe the role of the thermodynamical driving force in reactions between metals

and silicon, the Co-Si system was chosen for investigation. In general, three silicide phases are formed during thermal annealing of samples consisting of Co thin films deposited on Si substrates, i.e., Co_2Si (the first phase to form with a heat of formation, ΔH/sub f/ = -9 kcal/g atoms), CoSi (ΔH/sub f/ = -12 kcal/g atoms), and $CoSi_2$ (the last phase to form, with ΔH/sub f/ = -8.2 kcal/g atoms). Previous experiments have shown that annealing a sample of Si/CoSi/Co converts CoSi into Co_2Si instead of a continuous growth of CoSi. This type of reaction is apparently unrelated to the magnitude of the thermodynamical driving force since ΔH/sub f/ of CoSi is significantly larger than those of Co_2Si and $CoSi_2$, but is kinetically restricted instead. Under ion mixing conditions the kinetic restriction is expected to relax due to enhanced atomic mobilities under ion irradiation; the ion-induced reactions should then be driven by thermodynamics; i.e., growth of the phase with the largest ΔH/sub f/ is favored. In this work, phase formation induced thermally and with ion mixing in the Co-Si system was investigated using Rutherford backscattering spectrometry and x-ray diffraction (Read camera). It was found that in thermal annealing, Co_2Si is the first phase to form and Co is the dominant moving species in the formation of Co_2Si, in agreement with previous results. In ion mixing, both CoSi and Co_2Si are observed to form. At low temperatures, the formation of CoSi dominates.

15179 **Internal stress minimization in the fabrication of transmissive multilayer x-ray optics.** Jankowski, A.F.; Bionta, R.M.; Gabriele, P.C. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 2, 210-213(Mar 1989).

Transmissive multilayer optics have a potential application in the development of high-resolution x-ray microscope and spectrometer systems. Difficulties encountered in the sputter deposition of these multilayer optical structures can be overcome by careful control of the fabrication parameters. The deleterious effects of compressive or tensile intrinsic stresses can be minimized by optimizing both substrate temperature and working gas pressure during the deposition process. This study specifically considers the Al/Ta multilayer combination.

15180 **Comparison of M-region x-ray and Auger electron spectra for near-threshold electron excitation of metallic and oxidized lanthanum.** Wachter, J.R.; Liefeld, R.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 2, 249-252(Mar 1989).

The M-region x-ray yield and Auger electron spectra of metallic and oxidized lanthanum were measured for electron excitation near the M_5 and M_4 ionization energies. The measurements show a chemical shift of 2.3 eV in the x-ray excitation spectra for the two species but no corresponding shift in the Auger electron spectra. This supports the hypothesis that two distinct excitation processes occur near the M_5 and M_4 ionization energies. One process results in an excited state which can decay through "characteristic" channels while the second process leads to a state which decays only by radiative emission.

15181 **Study of CdTe(111)B epilayers grown by molecular-beam epitaxy.** Monfroy, G.; Sivananthan, S.; Faurie, J.P.; Reno, J.L. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 2, 326-330(Mar 1989).

The growth of high-quality Hg/sub 1-//sub x/Cd/sub x/Te(111)B epitaxial layers involves the growth of a CdTe(111)B buffer layer, whether the growth is performed onto related or foreign substrates. CdTe(111)B layers have been investigated using the x-ray double-crystal rocking curve and the cathodoluminescence imaging techniques. The optimization of the growth conditions for CdTe(111)B layers is presented for a high-quality homoepitaxy. The heteroepitaxy of CdTe(111)B on GaAs(100) substrates is then discussed, in the case of GaAs substrates oriented (100), misoriented by 2° towards [110], and misoriented by 5° towards [111]. The results indicate that a 2° misorientation leads to CdTe(333) peaks with full width at half-maximum up to four times narrower then either of the other orientations tested. Furthermore, only threading dislocations were visible on this orientation by cathodoluminescence imaging.

15182 **Experimental Fermi surface of Mo(011).** Jeong, K.; Gaylord, R.H.; Kevan, S.D. (Department of Physics and Materials Science Institute, University of Oregon, Eugene, Oregon 97403-1274). *Physical Review [Section] B: Condensed Matter;* **39**: No. 5, 2973-2981(15 Feb 1989).

High-resolution angle-resolved photoemission results are presented which allow us to determine the complete Fermi surfaces for the surface-localized electronic levels on the clean and hydrogen-covered Mo(011) surfaces. Similar to previously presented data for W(011), we observe a total of three distinct closed hole orbits and one closed electron orbit. The hole orbits are elliptical and are centered on different projections of the same bulk Fermi-surface ellipsoid. They are located at the center and along each of the edges of the surface Brillouin zone. The surface electron pocket is closed but has a very complex shape which is somewhat different from the one observed on W(011). It orbits the projection of a bulk electron pocket which is traditionally called a jack, and is centered in the surface Brillouin zone. As was observed for W(011), these orbits are affected to different extents by hydrogen adsorption. The hole pockets are rapidly quenched by hydrogen, while the electron pocket grows in area until it merges with its image in the second Brillouin zone. At saturation there exist two hole pockets which are the remnants of the clean-surface electron pocket. These results are discussed in terms of the dynamical response of the surface. Electronic damping mechanisms for low-energy surface excitations are discussed. Some of the possible vibrational Kohn anomalies are enumerated.

15183 **Low-temperature properties of an Yb impurity in a metallic host with an axial crystalline field.** Rasul, J.W.; Schlottmann, P. (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122). *Physical Review [Section] B: Condensed Matter;* **39**: No. 5, 3065-3076(15 Feb 1989).

The Bethe-Ansatz equations for the ground state of the Coqblin-Schrieffer model for j = 7/2 are solved for a special axial-crystal-field-splitting scheme. The occupations of the crystal-field levels, the specific-heat contribution linear in the temperature, and the magnetic susceptibility parallel and perpendicular to the crystal axis are obtained as a function of the crystal-field strength. The universality of the results is discussed and a comparison with experiments on $YbCu_2Si_2$ and YbCuAl is made.

15184 **Adsorption distance of S on Ni(001): An electron-energy-loss-spectroscopy cross-section analysis of the Ni(001)-c(2 x 2)S system.** Wu, Z.Q.; Chen, Y.; Xu, M.L.; Tong, S.Y.; Lehwald, S.; Rocca, M.; Ibach, H. (Department of Physics and Laboratory for Surface Studies, University of Wisconsin—Milwaukee, P.O. Box 413, Milwaukee, Wisconsin 53201). *Physical Review [Section] B: Condensed Matter;* **39**: No. 5, 3116-3124(15 Feb 1989).

The inelastic-electron-scattering cross sections of surface and antinode adsorbate-induced bulk phonons are calculated for the Ni(001)-c(2 x 2)S system. The calculated cross sections are sensitive to variations in the incident electron energy, phonon q/sub X/, and the spacing between S and Ni layers. By comparing calculated cross sections with measured electron-energy-loss spectra at different electron energies and phonon q/sub X/ vectors, we determined the S-Ni spacing unambiguously at 1.35 A. An ad hoc non-central-force model was introduced to explain the measured dispersion curves.

15185 **Acoustic velocities and phase transitions in molybdenum under strong shock compression.** Hixson, R.S.; Boness, D.A.; Shaner, J.W.; Moriarty, J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **62**: No. 6, 637-640(6 Feb 1989).

We present acoustic velocity data that demonstrate high-pressure solid-solid phase transition in molybdenum at about 2.1 Mbar and 4100 K. This observation is supported here by first-principles theoretical calculations which predict a zero-temperature

bcc→hcp transition within our experimental pressure range. In addition, our results show the melting transition for shock-compressed Mo at about 3.9 Mbar and 10 000 K.

15186 **Resistivity of strong-scattering alloys: Absence of localization and success of coherent-potential approximation confirmed by exact supercell calculations in V/sub 1-//sub x/ Al/sub x/.** Brown, R.H.; Allen, P.B.; Nicholson, D.M.; Butler, W.H. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York, 11794-3800). *Physical Review Letters;* **62**: No. 6, 661-664(6 Feb 1989).

A supercell procedure for exact evaluation of the one-electron Kubo-Greenwood formula is applied to the resistivity rho of V/sub 1-//sub x/Al/sub x/ alloys and compared with a Korringa-Kohn-Rostoker coherent-potential approximation calculation. The results of these calculations agree well, consistent with the observation of delocalized eigenstates, in spite of the very high resistivity, rho≅200 μΩ cm.

15187 **Optical evidence for the metallization of xenon at 132(5) GPa.** Goettel, K.A.; Eggert, J.H.; Silvera, I.F.; Moss, W.C. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review Letters;* **62**: No. 6, 665-668(6 Feb 1989).

We have compressed xenon in a diamond-anvil cell to approximately 200 GPa. The metallization of xenon by band-gap closure was investigated by obtaining optical data for xenon in both the metallic and insulating states. In the metallic state, we determined the pressure dependence of the plasma frequency from absorption-data fit with a free-electron model. In the insulating state, we determined the pressure dependence of the band gap from absorption data fit with an indirect band-gap model. Our optical data indicate that the insulator-to-metal transition in xenon occurs at 132(5) GPa.

15188 **Evidence for the insulator-metal transition in xenon from optical, x-ray, and band-structure studies to 170 GPa.** Reichlin, R.; Brister, K.E.; McMahan, A.K.; Ross, M.; Martin, S.; Vohra, Y.K.; Ruoff, A.L. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **62**: No. 6, 669-672(6 Feb 1989).

The equation of state and optical absorption of condensed Xe have been measured in a diamond-anvil cell up to 172 GPa. Pressures were determined by use of the ruby fluorescence technique or from the equation of state of the Re gasket used to confine the sample. Xe transformed to an hcp structure between 70 and 90 GPa that remained stable to 172 GPa. At 150 GPa we observed sudden changes in absorption and reflection spectra of Xe that we attribute, on the basis of electron band calculations, to the onset of metallization.

15189 **Low-temperature localized motion of hydrogen and electronic structure transition in hexagonal-close-packed scandium.** Lichty, L.R.; Han, J.; Ibanez-Meier, R.; Torgeson, D.R.; Barnes, R.G.; Seymour, E.F.W.; Sholl, C.A. (Ames Laboratory, and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2012-2021(1 Feb 1989).

We report nuclear magnetic resonance (NMR) measurements of the proton (^{1}H) spin-lattice relaxation rate (R_1) in the hexagonal-close-packed (hcp) solid solution (α) phase of the Sc-H system over the temperature range 10—300 K in which hydrogen pairs are known to form. At low temperatures (10—120 K), fast localized motion of hydrogen between closely spaced tetrahedral interstitial sites in the lattice gives rise to a peak in the relaxation rate. Both the temperature and frequency dependences of the relaxation rate peak exhibit characteristics typical of amorphous and disordered systems, suggesting the formation of hydrogen pairs with little long-range order results effectively in a "proton glass" within the metal lattice. The measurements reveal an electronic structure transition near 170 K where the unpaired electron spin density at the proton sites decreases with increasing temperature.

15190 **Resistance anomaly near the localized-delocalized crossover point in the CeSi/sub x/ system.** Gschneidner K.A. Jr.; Lee, W.H.; Damento, M.A.; Tang, J.; Cook, B.A.; Shinar, J.; Dehner, B.; Shelton, R.N. (Ames Laboratory and Department of Materials Science and Engineering Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2099-2105(1 Feb 1989).

Anomalies in the temperature dependence of the electrical resistivity have been observed in the CeSi/sub x/ series of alloys near x = 1.855. The resistivity versus composition behavior over a 0.2 at. % composition range looks like a δ function with a decrease of about 1 order of magnitude in the resistivity on either side of the peak at CeSi/sub 1.855/, which is near the localized-delocalized crossover point. The large change in resistivity on heating or cooling apparently is due to crack formation upon cooling between 150 and 50 K, and also to crack opening or closing above and below this temperature range.

15191 **Magnetic susceptibility and low-temperature heat capacity of $CePd_3B$/sub 0.3/.** Dhar, S.K.; Gschneidner K.A. Jr.; Bredl, C.D.; Steglich, F. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2439-2441(1 Feb 1989).

The heat capacity of $CePd_3B$/sub 0.3/ has been measured between 80 mK and 2.5 K in zero and applied fields up to 4 T. The specific heat exhibits a Schottky-like anomaly, nearly symmetric on a lnT scale, which is shifted to higher temperatures in applied fields. High-temperature susceptibility measurements confirm a near trivalent state of Ce in $CePd_3B$/sub 0.3/ while the ac susceptibility in the range 0.15 to 0.7 K displays a cusp at 0.45 K which is smeared out in applied fields indicating a spin-glass transition. Kondo interactions are also operative as evidenced by the large value of C/T as T→0.

15192 **P-T-H phase diagram of heavy-electron UCd/sub 11/.** Thompson, J.D.; Fisk, Z.; McElfresh, M.W.; Ott, H.R.; Maple, M.B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2578-2582(1 Feb 1989).

At ambient pressure UCd/sub 11/ undergoes a phase transition near 5 K that is believed to arise from antiferromagnetic order within a strongly correlated electron system. Under moderate hydrostatic pressures, two new phase transitions appear below 5 K that are manifested by anomalies in the temperature-dependent electrical resistivity. We present the evolution of these transitions with pressure, temperature, and magnetic field and discuss possible interpretations of their origin given the pressure dependence of the resistivity and magnetic susceptibility.

15193 **Eu_2CuO_4: An anisotropic Van Vleck paramagnet.** Tovar, M.; Rao, D.; Barnett, J.; Oseroff, S.B.; Thompson, J.D.; Cheong, S.; Fisk, Z.; Vier, D.C.; Schultz, S. (San Diego State University, San Diego, California 92182). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2661-2663(1 Feb 1989).

Magnetic susceptibility measurements have shown anisotropic Van Vleck paramagnetism in Eu_2CuO_4 single crystals. This behavior is associated with the singlet ground state ($^7F_0$) of Eu/sup 3+/ ions, and the measured anisotropy is related to a crystal-field splitting of the excited multiplets (^7F/sub J/). From the experimental data at low temperatures (Tapprox. <50 K) a crystal-field parameter $A_2{}^0\langle r^2\rangle$ = -93(5) cm/sup -1/ and a spin-orbit coupling constant zeta = 303(15) cm/sup -1/ have been estimated. The temperature dependence of the magnetic susceptibility is predicted in terms of the Boltzmann population of the excited multiplets, and a comparison with experimental data up to 350 K is made. The possibility of a magnetic contribution arising from the Cu ions is discussed in connection with some discrepancies observed between the experimental and calculated magnetic susceptibilities.

15194 Low-temperature heat-capacity study of the U_6X (XequivalentMn, Fe, Co, Ni) compounds. Yang, K.N.; Maple, M.B.; DeLong, L.E.; Huber, J.G.; Junod, A. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 151-166(1 Jan 1989).

Measurements of the superconducting- and normal-state heat capacity of U_6X (XequivalentMn, Fe, Co, Ni) compounds have been performed over a temperature range 1 Kapprox. <Tapprox. <35 K. The U_6X compounds have strong renormalizations of the free-carrier effective mass m/sup */ in the range 10m/sub e/ approx. <m/sup */approx. <50m/sub e/ (m/sub e/equivalentfree-electron mass). The unusual magnitude and temperature dependence of the U_6X heat capacities suggest the presence of high densities of low-energy excitations of undetermined nature. The results are analyzed in terms of models appropriate to heavy-fermion liquids, and anisotropic or strong-coupled superconductors. The U_6X compounds form a link between relatively low-m/sup */, high-transition-temperature A15 compounds and the more extreme examples of heavy-fermion superconductors such as UBe_{13}, UPt_3, and $CeCuSi_2$ for which m/sup */$\sim 10^2$m/sub e/. .AE

15195 Atomic structural transformations on clean metal surfaces. Kellogg, G.L.; Schwoebel, P.R. (Sandia National Labs., Albuquerque, NM (US));. *Journal of Metals;* **40**: No. 10, 49-50(Oct 1988).

Two types of structural transformations which occur on clean, single-crystal surfaces have been investigated in atomic detail at Sandia National Laboratories. The restructuring of surfaces from "bulk-terminated" to "reconstructed" structures and the configuring of cluster nuclei between two-dimensional islands and one-dimensional chains have been examined by field ion microscopy, a technique which provides direct images of individual surface atoms. Observations of the bulk-terminated (unreconstructed) Pt (110) surface with the field ion microscope surface indicate that atoms in the topmost layer are aligned in rows adjacent to each other. The unreconstructed surface is produced by a process known as field evaporation (i.e. the removal of atoms by a high electric field at temperatures of 77K), which typically leaves a surface with the bulk-terminated structure. This metastable surface is found to transform to the equilibrium, reconstructed surface at temperatures above 300K.

15196 The high-temperature impact properties of DOP-26 iridium. George, T.G.; Stevens, M.F. (Los Alamos National Lab. in Los Alamos, NM (US));. *Journal of Metals;* **40**: No. 10, 32-35(Oct 1988).

A study of the impact properties of DOP-26 iridium (which contains 0.3% tungsten and —40 pm thorium) at temperatures of 600 to 1,440°C revealed that the predominant mode of failure for the material is intergranular separation with occasional transgranular cleavage. DOP-26 iridium also appears to have a high notch sensitivity, in contrast to most other face-centered-cubic (fcc) metals; at elevated deformation temperatures, the dislocation substructure is similar to that of other fcc metals. In addition, regular arrays of pure edge character dislocations have been found. In the test specimens used in this study, the presence of Ir Th particles was observed within iridium grains. The existence of these particles indicates that the role of thorium is not well understood, particularly in light of the fact that previous studies, which depended on grain boundary segregation, have shown thorium to improve grain boundary cohesion.

15197 Theoretical and experimental determinations of the thermal stability of rare earth oxide particles in rapidly solidified titanium alloys. Konitzer, D.G.; Lofvander, J.P.A.; Court, S.A.; Fraser, H.L. (The Alcoa Technical Center, Alloy Technology Div., Alcoa Center, PA (US)); Kircheim, R. (Max-Planck-Institut fur Metallforschung, Institut fur Werkstoffwissenschaften, D-7000 Stuttgart 1 (DE)). *Acta Metallurgica;* **36**: No. 6, 1595-1606(Jun 1988).

The general stability of a dispersion of rare earth oxide particles in Ti has been considered analytically and determined experimentally. Regarding the analytical approach, the solubility product for the formation of erbia from its constituents in a Ti matrix has been calculated using thermodynamic data. This allows the concentration term in the equations for Ostwald ripening to be calculated. This calculation predicts different stabilities for a dispersion of erbia particles depending on whether the alloy contains an excess of Er or oxygen with respect to the formation of the rare earth oxide, Er/sub 2/O/sub 3/. The rate of coarsening is more rapid in samples with an excess of Er compared to those with an excess of oxygen. Both predictions have been verified experimentally by forming the dispersion through heat-treatment at 700°C and performing isochronal anneals at higher temperatures to determine the resistance to particle coarsening. Isothermal annealing has been employed to demonstrate that the coarsening involves bulk diffusion, i.e. t/sup 13/ kinetics, and a satisfactory agreement between theoretically derived rate constants and those deduced from experiment has been achieved.

15198 The microstructure of rapidly solidified and heat-treated Ti alloys containing La. Court, S.A.; Stanley, J.T.; Fraser, H.L. (Dept. of Materials Science and Engineering, and the Materials Research Lab., Univ. of Illinois, 1304 W. Green Street, Urbana, IL (US)); Konitzer, D.G. (Alcoa Technical Center, Alloy Technology Div., Alcoa Center, PA (US)); Loretto, M.H. (Dept. of Metallurgy and Materials, Univ. of Birmingham B15 2TT (GB));. *Acta Metallurgica;* **36**: No. 6, 1585-1594(Jun 1988).

Ti and Ti-Al containing La additions have been rapidly solidified using laser surface melting. The microstructure consists of a distribution of particles in a matrix of α-Ti. The particles have been identified as LA (f.c.c.) using microdiffraction, and microchemical analysis (energy dispersive X-ray spectroscopy and electron energy loss spectroscopy). The La particles obey an orientation relationship with the matrix. On aging at 700°C, the La particles are internally oxidized, the nature of the particles being determined again by techniques given above. The oxide particles, with an hexagonal crystal structure, have an orientation relationship with respect to the matrix and the shape of the particles may be described as an hexagonal prism, which is consistent with the sharing of symmetry defined by this orientation relationship. A small number of particles are also formed as a result of annealing at 700°C. These are formed from decomposition of the slightly supersaturated matrix. The behavior of these alloys containing La is different from that of alloys containing either Er or Y, where relatively concentrated supersaturations of these rare-earth elements may be effected by rapid solidification. An explanation for this difference is given which is based on whether rapid solidification involves an eutectic (Er and Y) or monotectic (La) reaction.

15199 Kinetics of sensitization and de-sensitization of duplex 308 stainless steel. Devine, T.M. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab. and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA (US));. *Acta Metallurgica;* **36**: No. 6, 1491-1502(Jun 1988).

The kinetics of, and the factors responsible for, sensitization and de-sensitization were determined for duplex 308 stainless steel. Samples consisting of 10 vol.% of ferrite, balance austenite were heat treated at 600 and 550°C for times of 15 min-300h. The chromium contents of the α-γ boundaries and γ-γ grain boundaries of heat treated samples were measured by a potentiostatic electrochemical technique. Transmission electron microscopy of foils and surface replicas of heat treated samples was used to observe carbide precipitation on the boundaries and decomposition of the ferrite. Carbide precipitation occurred exclusively along the α-γ boundaries. Most of the chromium in the carbide came from the ferrite phase. However, intergranular corrosion susceptibility resulted from a chromium depleted zone that was formed on the austenite side of the interface and a chromium depleted zone that formed along the γ-γ grain boundaries. The latter developed in spite of the absence of carbides along the γ-γ grain boundaries. It resulted from grain boundary diffusion of chromium to the carbides growing along the α-γ boundaries. There was a maximum in the degree of sensitization with time of heat treatment. At aging times <t/sub max/, the degree of sensitization was limited by the achievement of a chromium depleted zone of a critical minimum width. An upper bound estimate of the latter was — 25A. At aging times >t/sub max/, de-sensitization occurred. This was controlled by the chromium content in the matrix at the carbide-matrix interface. Initially,

the rate of de-sensitization was rapid and was produced by chromium diffusing from the ferrite phase into the chromium depleted zone in the austenite. When the ferrite phase started to decompose the rate of de-sensitization decreased and was produced by volume diffusion of chromium in the austenite phase.

15200 **Theoretical analysis of strain-induced shape changes in cubic precipitates during coarsening.** Khachaturyan, A.G.; Semenovskaya, S.V.; Morris, J.W. Jr. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley and Center for Advanced Materials, Lawrence Berkeley Lab., Berkeley, CA (US)). *Acta Metallurgica;* **36**: No. 6, 1563-1584(Jun 1988).

The work reported here concerns the evolution of the shape of a coherent, cubic precipitate as it grows by coarsening. The work was motivated by the need to explain recent experimental observations that show that cuboidal γ Ni/sub 3/Al precipitates in Ni-Al alloys resist coarsening and decompose into doublets of parallel rectangular plates and octets of small cubes. The theoretical model assumes a precipitate of cubic phase with negative elastic anisotropy, and neglects any difference between the elastic constants of the precipitate and the matrix. The elastic energy of the precipitate is then calculated as a function of its morphology, including the possibility of decomposition into doublets or octets of discrete particles. The results show that a cuboidal precipitate with (100) faces and edge length, 2a, is metastable with respect to transition to a doublet of discrete plates, with dimensions a x 2a x 2a, that are separated by the distance μ - a, when the edge length exceeds a characteristic distance, that depends on the interfacial tension of the precipitate, its elastic constants, and its misfits with the parent lattice. When the edge length of the doublet exceeds a critical value, it becomes metastable with respect to transformation into an octet of cubic particles that have edge length {100} interfaces and an interparticle separation of 0.4a. The octet of particles becomes metastable with respect to coagulation into a thin plate on the (100) plane on further coarsening. If the interfacial tension is isotropic, the same analysis can be used to predict the transition from sphere to cube. The equilibrium transformation sizes are specifically computed for the case of γ Ni/sub 3/Al, and are consistent with the experimental data. The possible influence of the strain energy is on coarsening is also discussed.

15201 **Grain boundary composition effects on environmentally induced cracking of engineering materials.** Bruemmer, S.M. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US));. *Corrosion (Houston);* **44**: No. 6, 364-370(Jun 1988).

There is now clear evidence that intergranular stress corrosion cracking (IGSCC) and hydrogen embrittlement (HE) of engineering materials depend on grain boundary composition. Two examples are used to illustrate this interrelationship: (1) stress corrosion cracking (SCC) of austenitic stainless steel (SS) in high temperature water and (2) HE of NiCrMoV rotor steels in acidic solutions. Grain boundary compositions are characterized by analytical electron microscopy and scanning Auger electron spectroscopy. Environmental cracking susceptibility is indicated by slow strain rate tests (SSRTs) in appropriate aqueous environments. Direct correlations are documented between measured grain boundary compositions and environmental cracking. The ability to establish these types of correlations enables diagnosis of embrittlement susceptibility and helps identify methods to control to eliminate embrittlement by bulk chemistry or processing modifications.

15202 **Evaluation of TiB/sub 2/-based cathodes for aluminum processing applications.** Schilling, C.H.; Marschman, S.C. (Pacific Northwest Lab., Richland, WA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Research is being performed at the Pacific Northwest Laboratory to develop ceramic-based anodes and cathodes for retrofitting aluminum production plants to reduce the energy consumption during the alumina electrolysis process. Prime candidate designs for retrofitting existing commercial Hall-Heroult cells were selected from a literature review, and screening experiments were performed to evaluate the wear behavior of TiB/sub 2/-based cathodes used in these designs. Experiments primarily entailed microstructure analysis of TiB/sub 2/-based materials after non-polarized exposure to molten aluminum and after laboratory-scale electrolysis tests using NiO-NiFe/sub 2/O/sub 4/-based anodes. Acceptable wear resistance of both anodes and cathods was demonstrated; test data are used to support ongoing research to establish a basis for designing a pilot cell. Three retrofit designs were experimentally evaluated: 1) an array of TiB/sub 2/-based tiles that are affixed to carbon cell bottoms, 2) replaceable cathodes which rest, unattached, on carbon cell bottoms, and 3) replaceable electrode fixtures having ceramic spacers to attach the anodes to the cathodes and align the anode-cathode spacing. Electrolysis and immersion tests indicated that option 1 is not practical because carbonaceous substrates are erosively attacked by electrolyte and aluminum, resulting in eventual detachment of TiB/sub 2/-based tiles. Electrolysis tests indicated acceptable performance of options 2 and 3, although option exhibited wear of boron nitride spacers on surfaces adjacent to the anode-cathode spacing. Spacer wear may be alleviated by using alternative materials such as aluminum nitride.

15203 **Development and testing of non-consumable anodes for the electrolytic production of aluminum.** Marschman, S.C. (Pacific Northwest Lab., Richland, WA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

It has been determined that these materials may be successfully operated in cryolite-based electrolytes of bath ratios ranging from 1.1 to 1.4, and LiF additions to 1.5 wt% have been used without problem. Additionally, these materials have been successfully tested in electrolytes which had alumina concentrations below saturation. Preliminary data have indicated successful operation at alumina levels as low as 1 wt%. Metal impurities have been determined from electrolytically produced aluminum obtained from several laboratory-scale electrolysis cells which were each operated for 20 hrs. These results show that low impurity levels are obtainable in laboratory-scale electrolysis cells, and industry standards for Ni impurities (a previous concern when using these cermets) can be met (0.02 wt%). The average metal purity for these cells was 99.8%. Continued testing of these materials is required to confirm and build upon the results presented here. Although the results obtained to date are promising, long-duration testing and scale-up are required prior to acceptance by the aluminum industry. These tests are now the focus of an ongoing research effort at Pacific Northwest Laboratory.

15204 **Studies on high-speed electroforming.** Barkey, D.P.; Muller, R.H.; Tobias, C.W. (Dept. of Chemical Engineering, and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

To examine the role of the boundary layer in roughness development, the Fourier transform was used to separate features smaller than the boundary layer from the deposit profiles. Ibl proposed that large features should grow more uniformly than small ones because the boundary layer follows the larger contours. Smaller features are not uniformly inhibited because the peaks penetrate the boundary layer. It is therefore expected that the dependence of roughness development on conditions of mass transfer, or fraction of limiting current, should be more pronounced for the smaller features. A comparison was accomplished by using the Fourier transform to filter out features larger than 80 micrometers in spacing. Boundary layer thickness varied from 60 to 300 micrometers in the deposition experiments. The amplitude of the resulting 'fine-roughness profile' was then calculated. Amplitude was found to be independent of absolute current density, and to depend strongly on fraction of limiting current, in agreement with Ibl's mechanism. Thinning of the boundary layer, in addition to improved stability

and higher number density of nucleation, contributes to a substantial improvement in deposit surface finish as the absolute current density is increased under controlled mass transfer conditions.

15205 **Kinetic studies on the electrodeposition of uranium from fused salts.** Marshall, S.L.; Vissers, D.R. (Argonne National Lab., Chemical Technology Div., Argonne, IL (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Published research on the uranium electrode in fused chlorides has been directed toward determining the standard potentials of the U/U/sup III/ and U/sup III//U/sup IV/ half cells, and the steady-state kinetics of the reaction U → U/sup III/. Modern potentiostatic and galvano-static transient techniques do not appear to have been applied to this system. This paper describes the electrochemical transients for deposition of U onto Ni and Ta, from molten LiCl-KCl eutectic containing UCl/sub 3/.

15206 **Effect of varied alloy concentrations on performance for aluminum-air battery anodes.** Mitchell, L.K.; Turk, T.R. (Eltech Research Corp., 625 East Street, Fairport Harbor, OH (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The development of aluminum anodes for the aluminum-air battery necessitates the reduction of hydrogen evolution at open circuit and under polarization while maintaining acceptable potentials under an applied load. Previous work reported improved anode performance in alkaline electrolyte by the use of magnesium, manganese, and gallium as alloying agents in the presence of increased iron levels. Manganese was found to negate the effects of high iron, and the addition of magnesium resulted in more negative potentials and higher coloumbic efficiency. The studies in saline solutions showed a shift of the rest potential in the negative direction for the binary alloys using indium, gallium and thallium. The alloying agents indium and thallium also resulted in reduced corrosion. Recent studies on the development of aluminum anode alloys for aluminum-air batteries and recent experimentation conducted at ELTECH resulted in the selection of the alloying agents indium, magnesium, and manganese for investigation to model their performance as an aluminum-air anode as a function of the alloy concentration. The target for open circuit corrosion was 0.06 mg/cm/sup 2/-min., and the desired energy yield was 4.3 KWhr/kg aluminum at 200 mA/cm/sup 2/.

15207 **Surface crystallography.** Van Hove, M.A. (MCSD, Lawrence Berkeley Lab., Berkeley, CA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The detailed atomic positions at surfaces underlie most surface-related phenomena. Surface crystallography has evolved to provide such geometric information at single-crystal surfaces. Many techniques are currently available and complement each other in various ways. Chief among them: low-energy electron diffraction (LEED), which parallels bulk x-ray crystallography; ion scattering from low to high energies, which uses channeling and/or shadowing to detect atomic positions; surface extended x-ray absorption fine structure, which primarily measures bond lengths; angle-resolved photoelectron fine structure, which focuses on local diffraction to obtain local atomic configurations. Many other techniques contribute significantly, including x-ray diffraction and scanning tunneling microscopy. Remarkable detail in the structural analysis of reconstructed metal surfaces has been achieved: subsurface relaxations down to the fourth atomic layer can be discerned for Ir, Pt and Au (110)-(1x2). A famous semiconductor reconstruction, Si(111) (7x7), has now also been tested with LEED, confirming and refining the stacking-fault-and-adatoms model, as well as showing the complexity attainable with LEED. Another illustration of complexity is offered by benzine adsorption on transition metal surfaces. Here the molecule is found to be severely distorted on some metals and not on others, providing a link with catalytic mechanisms. In addition, structures of coadsorbed molecules have been successfully investigated by LEED, exhibiting mutual interactions that also relate to chemical interactions.

15208 **Optical second harmonic generation as a probe of interface composition and structure.** Anderson, R.J.; Hamilton, J.C. (Sandia National Labs., Livermore, CA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Optical second harmonic generation, SHG, is a new monolayer-sensitive technique which can provide structural and compositional information from interfaces at ambient pressures (e.g., electrochemical cells and catalytic reactors) and from buried solid-state interfaces. It provides remote sensing of surface composition at elevated temperatures as illustrated by experiments described here relating SH intensity to surface concentrations of chromium and nitrogen on Fe-18Cr-3Mo(110) in ultrahigh vacuum (UHV). Surface structures can be determined by measuring the SH intensity as a function of rotation about the surface normal, illustrated by experiments described here relating SH intensity to azimuthal orientation and hydrogen coverage of a Ni(111) surface in UHV. Optical second harmonic generation from interfaces is a process in which a fraction of the incident light is converted upon reflection to light at twice the incident frequency. In addition to polarizing sample electrons at the fundamental frequency, ω, of the incident laser beam, the strong electric fields induce a nonlinear source polarization, P/sub nls/, at 2ω which reradiates a coherent beam of light at the second harmonic frequency. In the point dipole approximation, P/sub nls/ is zero for bulk centrosymmetric media because of symmetry considerations. Only at interfaces between dissimilar materials in the symmetry broken giving rise to a nonlinear source polarization. Thus, interfaces make a major contribution to the total second harmonic radiation detected from centrosymmetric materials. This interface sensitivity is a major advantage of nonlinear optical spectroscopies over linear optical techniques such as Raman spectroscopy, which average over the penetration depth of the laser.

15209 **The effect of impurity anions on the voltametry of single crystal gold surfaces.** Villullas, H.M.; Cahan, B.D.; Yeager, E.B. (Case Center for Electrochemical Sciences, and the Dept. of Chemistry, Case Western Reserve Univ., Cleveland, OH (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The recent literature on the cyclic voltammetry of low index surfaces of Au single crystals has been replete with conflicting reports about the number, relative size and shape of the peaks observed in various electrolytes. The main questions that appear to be central are the quality and/or perfection of the surface and the nature and purity of the electrolyte. For example, the discussions and published data relative to the (111) face have variously attributed the observed differences to surface structure and preparation, nature of the relevant anions, and "impurities". The controversy re the (110) and (100) faces is not as well documented, but clear differences are observable between published curves, even in different papers by the same author(s). It is not possible to decide from the literature: 1. whether or not ClO/sub 4//sup -/ and F/sup -/ behave in a similar fashion, 2. the existence of specific adsorption of ClO/sub 4//sup -/ on Au, 3. the validity of the "fingerprint" concept of identification of developed faces, 4. the effect of traces of Cl/sup -/ on the shape of the curves, 5. whether cycling into the oxide region removes or concentrates impurities, 6. the restructuring of the surface by cycling and the effect of impurities on restructuring. The authors developed a new technique for the precise orientation, polishing and mounting of cylindrical single crystals for use as clean high speed (> 10,000 rpm) rotating disks in a hanging

meniscus. Using this mount, the authors have investigated these effects.

15210 **Nickel corrosion in 0.1 M NaOH.** Pellin, M.J.; Biwer, B.M.; Schauer, M.W.; Gruen, D.M. (Materials Science/Chemistry Divisions, Argonne National Lab., Argonne, IL (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Here, the authors report the use of a relatively new technique, Surface Second Harmonic Generation (SSHG) to study the corrosion of Ni in NaOH solutions. SSHG has been extensively used to study the electrochemistry of Ag surfaces. Unfortunately, the signal levels from Fe and Ni surfaces are more than two orders of magnitude smaller for a given input intensity than for Ag. Recently, they have used the high peak intensity at a given input energy of picosecond Nd:YAG laser pulses to enhance the signal level of SSHG in studies of the corrosion of Fe surfaces. These studies as well as the present study of Ni electrodes demonstrate the feasibility of using SSHG as a routine in situ surface probe for the study of metal corrosion.

15211 **Design of a model for the scaling of metals at high temperatures.** Wolf, J.S. (Clemson Univ., Clemson, SC (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The problem of determining an optimal model for the mechanism of scale-forming during the exposure of metals to high-temperature reactive gases is addressed. The scope of this model has been initially restricted to those metals with plastic scales which form primarily via the diffusion of cations. The nickel-oxygen system has been chosen as the testbed for the first phase of model development because it is one of singular simplicity and one for which there exists a wealth of conceptual and observational information. The principles of engineering design are utilized to define the logic protocol for the general problem and are then applied to assist in the determination of a model for the high-temperature oxidation of unalloyed nickel. The hybrid model, based upon the observations of many investigators, contains stored information and patterns which may permit it to serve as a benchmark for the further development of scale-building models. Because the problem of designing a hybrid model for the nickel-oxygen system has a true cybernetic character, and because it has been produced under the usual cost/performance/time constraint field of the engineer, the final output must necessarily be neither "absolute" nor "static" in character. Rather, the design process provides only a "best efforts" model as a solution to the problem based upon information currently available. Fortunately, that process also provides a method for future guidance which will lead to improved outputs as its constraints are modified or as new information is input.

15212 **Laser Raman spectroelectrochemical studies of anodic corrosion and film formation on nickel and iron in aqueous solutions.** Melendres, C.A.; Camillone, N. (Materials Science Div. and Chemical Technology Div., Argonne National Lab., Argonne, IL (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Laser Raman spectroscopy has become an important tool for the study of electrochemical systems and processes because of the molecular specific information it provides on the structure of the solid-solution interface. The authors have been using the technique to elucidate corrosion and passivation phenomena on metals in aqueous environments under widely varying conditions of composition, pH, and temperature. They present here some results on nickel and iron in solutions containing traditionally known corrosion inhibiting anions like CrO/sub 4//sup =/ and PO/sub 4//sup identical to/, as well as non-inhibiting ones such as ClO/sub 4//sup -/ and SO/sub 4//sup =/.

15213 **Effect of double layer structure on the determination of corrosion rates from polarization measurements.** Nagy, Z.; Schultz, P.F. (Argonne National Lab., Divisions of Materials Science and Chemical Technology, Argonne, IL (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The generally used polarization equation which forms the basis of the calculation of corrosion rates from electrochemical measurements completely neglects the effect of the double layer structure on the kinetics of electrochemical reactions. Other treatments don't permit the determination of the experimental conditions, in terms of easily measurable parameters, for which the double layer effect can be safely ignored in practical corrosion measurements or the conditions under which the effect becomes important. It is the intent of the present work to determine these conditions.

15214 **Role of crack tip shielding in the initiation and growth of long and small fatigue cracks in composite microstructures.** Shang, J.K.; Tzou, J.L.; Ritchie, R.O. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA (US));. *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 9, 1613-1628(Sep 1987).

The role of crack tip shielding in retarding the initiation and growth of fatigue cracks has been examined in metallic composite microstructures (consisting of hard and soft phases), with the objective of achieving maximum resistance to fatigue. Specifically, duplex ferritic-martensitic structures have been developed in AISI 1008 and 1015 mild steels to promote shielding without loss in strength. The shielding is developed primarily from crack deflection and resultant crack closure, such that unusually high long crack propagation resistance is obtained. It is found that the fatigue threshold ΔK/sub TH/ in AISI 1008 can be increased by more than 100 pct to over 20 MPa √m, without sacrifice in strength, representing the highest ambient temperature threshold reported for a metallic alloy to date. Similar but smaller increases are found in AISI 1015. The effect of the dual-phase microstructures on crack initiation and small crack (10 to 1000 μm) growth, however, is markedly different, characteristic of behavior influenced by the mutual competition of intrinsic and extrinsic (shielding) "toughening" mechanisms. Accordingly, the composite microstructures which appear to show the highest resistance to the growth of long cracks, show the lowest resistance to crack initiation and small crack growth. In general, dual-phase steels are found to display remarkable fatigue properties, with fatigue limits as high as 58 pct of the tensile strengths and fatigue thresholds in the range of 13 to 20 MPa√m.

15215 **Atomistic simulations of surface relaxations in Ni, Al, and their ordered alloys.** Chen, S.P.; Voter, A.F.; Srolovitz, D.J. (Los Alamos National Lab., Los Alamos, NM 87545 (US));. pp v of Characterization of defects in materials. Siegel, R.W.; Weertman, J.R.; Sinclair, R. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors have performed a series of simulations to examine the atomistic nature of surface relaxations in pure metals and ordered alloys. The surface relaxations (Δ/sub n,n+1/) are shown to be oscillatory and to decay rapidly into the bulk. The period and form of the oscillation may be determined by simple geometrical arguments. The oscillation wavelength is always of the order of an atomic diameter. In pure metals, the surface layer of atoms always displaces inward. However, in the ordered alloys the larger atom may displace outward. On planes composed of more than one atom types, rippling occurs.

15216 **Detection of near-surface /sup 52/Cr segregation in irradiated /sup 51/V(Cr) by RBS.** Rehn, L.E.; Baldo, P.M. (Materials Science Div., Argonne National Lab., Argonne, IL (US));. pp v of Characterization of defects in materials. Siegel, R.W.; Weertman, J.R.; Sinclair, R. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Irradiation at elevated temperatures of V(Cr) alloys is known to create a near-surface layer of nonequilibrium Cr enrichment. Highly reproducible RBS spectra were accumulated from A V-15%Cr alloy irradiated at 750°C, and from unirradiated portions of the same specimen. Differences between these spectra are used to demonstrate the high sensitivity of conventional RBS techniques for determining near-surface segregation behavior. Sensitivities obtained utilizing differences in the acquired spectra are much higher than those typically assumed for RBS measurements. Using 1.8 MeV /sup 4/He, and conventional RBS equipment and scattering geometries, segregation of ≦ two atomic layers of /sup 52/Cr in /sup 51/V-15at.%Cr over a depth of —5 nm has been observed.

15217 **Application of a grain-size-sensitive model to determine the effect of yttrium additions on the oxidation of nickel.** Hsu, H.S. (Oak Ridge National Lab., PO Box X, Oak Ridge, TN (US)). pp v of Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J.; King, W.E. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-861076—).

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

The beneficial effect of active-element additions in metals and alloys on the formation of protective oxide scales is well known. Such additives will generally result in better scale adhesion and slower oxidation rates. In order to understand the role of active-element additions to the scale, a grain-size-sensitive model is proposed to determine the effect of yttrium on the grain boundary diffusion rate of nickel in NiO using oxidation kinetics and oxide grain size data that are available in the literature. It was found that the addition of yttrium to nickel decreases grain boundary diffusion of nickel in NiO at $T > 800°C$. At 900°C and 0.3% yttrium in nickel, the grain boundary diffusion rate of nickel in NiO can be reduced by a factor of 15. At $T < 700°C$, the addition of yttrium to nickel has no effect on the oxide grain boundary diffusivity. Good agreement was found between oxide grain boundary diffusivities calculated from this analysis and those determined by tracer-sectioning experiments.

15218 **AES, XPS, RBS, NRA and laser raman studies of high temperature corrosion.** Baer, D.R.; Dake, L.S. (Pacific Northwest Lab., PO Box 999, Richland, WA (US));. pp v of Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J.; King, W.E. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-861076—).

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

This paper describes the basic principles of five surface and near surface analysis methods and explores ways they can be used to gather information relevant to oxidation and high temperature corrosion. The techniques discussed include: Auger electron spectroscopy, X-ray photoelectron spectroscopy, Rutherford backscattering spectroscopy, nuclear reaction analysis and laser Raman spectroscopy. Advantages and limitations of each method are highlighted. To illustrate the types of information available, four of the techniques have been used to examine the oxide formed on a nickel-chromium-thoria alloy. Other examples, original and from the literature, are used to demonstrate special characteristics of the techniques. Particular attention is devoted to the possibilities and limitations of high temperature studies in ultra high vacuum analytical systems.

15219 **The effect of Y ion implantation on the oxide growth kinetics in Fe-24Cr.** King, W.E.; Grabowski, K.S.; Baldo, P.M. (Materials Science Div., Argonne National Lab., Argonne, IL (US));. pp v of Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J.; King, W.E. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-861076—).

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

The authors have investigated the effect of Y ion implantation on the high temperature oxidation of Fe-24Cr using Rutherford backscattering spectroscopy and analytical electron microscopy. Results indicate that implantation of Y has a very large effect on the growth rate of the oxide compared to metals alloyed with Y. Analytical tools have been applied to determine the spatial distribution of Y and the microstructure of the oxide. Results are compared with those of recent cation grain boundary diffusion measurements in Cr/sub 2/O/sub 3/ and Cr/sub 2/O/sub 3/ doped with Y/sub 2/O/sub 3/.

15220 **The effect of reactive element on cation self-diffusion in Cr/sub 2/O/sub 3/.** Park, J.H.; King, W.E.; Peterson, N.L.; Rothman, S.J. (Materials Science Div., Argonne National Lab., Argonne, IL (US));. pp v of Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J.; King, W.E. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-861076—).

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

The effect of small additions of yttrium on the tracer diffusion of Cr in Cr/sub 2/O/sub 3/ has been investigated both on samples sintered from Cr/sub 2/O/sub 3/ powder and on oxide layers formed by the oxidation of Cr metal and Cr-Y alloy. The results contradict some views of the reactive element effect, without, however, elucidating its nature in a completely satisfactory way.

15221 **Oxidation of alloys in bioxidants.** Natesan, K. (Materials and Components Technology Div., Argonne National Lab., Argonne, IL (US)). pp v of Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J.; King, W.E. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-861076—).

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

Oxidation of metallic materials at elevated temperatures in bioxidant environments is a potential problem in many systems within the chemical, petroleum, and power-generating industries. In this paper, thermodynamic and kinetic aspects of scaling of alloys in complex gas mixtures are presented with emphasis on the role of the second oxidant in the oxidation process. The requirements for protective scale developments in Cr/sub 2/O/sub 3/ - and Al/sub 2/O/sub 3/-forming alloys and the causes of scale breakdown are given. Experimental data from a variety of sources are used to examine the role of cation and sulfur transport through the scales and morphological changes in the scale, alloy, and scale/metal interface in the onset of breakaway corrosion in structural alloys. The sequence of events from initial formation of an oxide scale on an alloy surface to scale breakdown and catastrophic sulfidation is identified. Several avenues are presented for modification of alloys to achieve improved corrosion resistance in bioxidant gas atmospheres.

15222 **ARUPS studies of the interaction of CO with the interface states for strained-layer Cu on Ru(0001).** Houston, J.E.; Peden, C.H.F.; Feibelman, P.J.; Hamann, D.R. (Sandia Nat. Labs., Albuqurque, NM (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

During the growth of the first monolayer, Cu has been shown to form in 2d islands pseudormphic to the Ru(001) surface under a tensile strain of —6%. The chemical behavior of such films has been found to be unlike that of either of the pure elements both

from the standpoint of catalytic activity and molecular adsorption properties. In addition, these strained-layer films have unique electronic properties. Specifically, we have identified a set of interface and surface states near the K-bar point in the surface Brillioun zone. Here are shown new results concerning the behavior of the interface states with respect to CO adsorption. Specifically, CO is found to attenuate all Cu/Ru ARUPS structures except those due to the antibonding components of the interface states and these components move to higher binding energy with CO coverage. An analysis of these results, based on the properties of the interface states, indicates that there is negligible direct interaction between the CO orbitals and the metal d states. The increased bonding that is seen for CO on Cu/Ru compared to CO on Cu is suggested to result from an enhanced polarizability of the Cu 4s states due to the proximity of the Ru substrate.

15223 **Adsorption of oxygen on sodium saturated Cu{110}.** Grider, D.E.; Wendelken, J.F. (Oak Ridge Nat. Lab., Oak Ridge, TN (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

The adsorption of oxygen on a sodium saturated Cu{110} surface is examined with x-ray photoelectron spectroscopy (XPS) in an extension of a previous study of this system which utilized low energy electron diffraction (LEED), and high resolution electron energy loss spectroscopy (HREELS). The sodium overlayer, despite the presence of an initial oxide contaminant, shows metallic character. Intentionally adsorbed oxygen is in a different chemical state than the initial oxygen contaminant and causes a reduction in the metallic character of the sodium. The sticking coefficient for oxygen on the sodium saturated surface is almost three times greater than for the bare Cu{110} surface.

15224 **Ag layers on Cu(110).** Taylor, T.N.; Hoffbauer, M.A.; Borodovsky, L.; Beery, J.G.; Maggiore, C.J. (Los Alamos Nat. Lab., Los Alamos, NM (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

The atomic-level properties (bonding, structure, composition) and thermal stability of Ag overlayers on Cu(110) have been investigated using combined surface and high energy ion beam techniques. Analysis of the first Ag adatom layer with LEED shows that the Ag is initially confined to the [110bar] troughs and that further deposition results in a Ag(111) layer exhibiting c(2x4) symmetry. Rutherford backscattering analysis gives absolute coverages that are consistent with the surface science coverage determination. Thermal deposition of CO from the trough composite reveals a lower (more Ag-like) binding energy than that for clean Cu(110). Continuous films grown cold at thicknesses <115 A are found to agglomerate above 500 K exposing a tenacious Ag-Cu interface like that formed by one monolayer deposition. Ion beam analysis has been employed to characterize the agglomerate coverage and depth distribution for these degraded films. Thin films grown A thick exhibit much higher thermal stability, giving detectable interfacial degradation only after heating above 725 K.

15225 **Electronic and vibrational properties of single crystal surfaces of NiAl.** Lui, S.C.; Mundenar, J.M.; Plummer, E.W.; Mostoller, M.E.; Nicklow, R.M.; Zehner, D.M.; Ford, W.K.; Erskine, J. (Oak Ridge Nat. Lab., Oak Ridge, TN (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Surface and bulk electronic structure of the ordered NiAl alloy were measured using angle resolved photoelectron spectroscopy. The measured bulk d-bands (Ni like) were observed to be narrower than theoretically calculated d band widths which are 20 to 40% wider (depending upon what is used as a measure of the width). At least two surfaces states were observed on both the (110) and (111) surfaces. The nature of these surface states and their relationship to the bulk band structure is discussed. Dispersion of bulk phonons was measured by neutron scattering and fitted with a fourth nearest neighbor Born-von Karman model. Dipole active surface phonons on the (110) and (111) surfaces also observed by inelastic electron scattering and the frequencies also calculated assuming a truncated bulk surface. The calculated surface modes present a qualitative picture of the atomic displacement at each surface and also show that the surface phonon energy and intensity depends upon the structure of the surface.

15226 **Carbon monoxide adsorption on (111) and (110) single-crystal nickel-aluminum alloy surfaces.** Mundenar, J.M.; Gaylord, R.H.; Lui, S.C.; Plummer, E.W.; Zehner, D.M.; Ford, W.K.; Sneddon, L.G. (Oak Ridge Nat. Lab., Oak Ridge, TN (US)). pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Carbon monoxide chemisorption on the (111) and (110) surfaces of a single-crystal NiAl alloy has been studied using several surface sensitive techniques, including work function change measurements, ultra-violet photoelectron, thermal desorption and electron energy loss spectroscopy. Results from these experiments indicate that the reactivity of these NiAl surfaces toward CO is distinctly different and that although the CO/NiAl (110) behaves more like CO adsorbed on pure nickel surfaces, the CO/NiAl(110) surface is neither like CO absorbed on pure nickel nor aluminum surfaces. The local CO bonding sites, as probed photoemission and electron energy loss spectroscopy, are similar on both NiAl surfaces.

15227 **Studies of surface composition and phase transition of Mo-5%Re(100).** Wang, G.C.; Zehner, D.M.; Eaton, H.C. (Oak Ridge Nat. Lab., Oak Ridge, TN (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Surface composition of a clean Mo-5%Re(100) alloy was determined quantitatively by Auger Electron Spectroscopy and X-Ray Photoelectron Spectroscopy. A slight enrichment of Re on the alloy surface was found at and below room temperatures and the result is consistent with the prediction by a graphical approach for segregation. The change of surface composition due to gas contamination and sputtering were also studied. In contrast to the pure Mo(100) surface where a structural phase transition occurs below room temperature, low energy electron diffraction showed no structural change down to 160 K. However, for H, CO, N chemisorptions and C segregation on the alloy surface, LEED patterns similar to the ones observed from a pure Mo(100) surface were observed.

15228 **Structural energetics of thin coherently strained metallic overlayers.** Dodson, B.W.; Taylor, P.A. (Sandia Nat. Labs., Albuqurque, NM (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Understanding of the growth, stability, and structural properties of coherently strained metal overlayers has achieved considerable importance because of the recent discovery of unique interfacial electronic states and catalytic properties of such systems. The structural stability of coherently strained metal films grown on a

substrate composed of a different and lattice-mismatched metal is determined via atomistic calculations. An equilibrium energy balance criterion is used, which is evaluated with a Monte Carlo annealing optimization procedure in which the structural energy of the bimetallic system is obtained using the embedded atom method. The stability of coherently strained (100) bimetallic structures chosen from combinations of the fcc metals Ag, Au, Cu, Ni, Pd, and Pt has been studied. The predicted critical thickness agree remarkably well with experimental results, but disagree quantitatively with the continuum models.

15229 **Modification of the properties of metal overlayers on Nb(110) and Ta(110).** Ruckman, M.W.; Strongin, M.; Pan, X. (Brookhaven Nat. Lab., Upton, NY (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Modification of the physical and chemical properties of noble and near-noble metal monolayer films supported on Nb(110) or Ta(110) is demonstrated using photoemission and LEED. Strong adlayer-substrate bonding leads to the formation of commensurate Pd or Pt overlayers at low coverage ($\theta < 0.7$ ML). Ni and Cu form incommensurate structures because the additional interfacial misfit cannot be overcome by substrate-overlayer bonding. Ag and Au form commensurate overlayers at coverages less than 3 ML because the lattice misfit is small. The strong overlayer-substrate bonding produces large changes in the chemical activity of near-noble metal overlayers. Photoemission measurements on Pt monolayers show that the hybridized metal d-states are shifted further below the Fermi level "E/sub F/" and show a reduction in the surface density of states at E/sub F/. This absence of bonding d-states near E/sub F/ effects CO chemisorption. However, as additional layers of Pd and Pt are deposited, the d-occupancy, at E/sub F/ grows, with "constant" atomic structure and the amount of CO increases. Hence, in these systems chemisorption changes can be studied as a function of changing electronic structure while holding the surface structure fixed.

15230 **Calculation of the surface segregation of Pd-Cu, Pd-Ag, and Pd-Au alloys.** Foiles, S.M. (Sandia Nat. Labs., Livermore, CA (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. London, England; Kogan Page Ltd. (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

The surface composition of the (111) surfaces of the binary allows Pd-Cu, Pd-Ag, and Pd-Au have been computed by Monte Carlo computer simulation with the energetics determined by the Embedded Atom Method. Ag and Au are found to segregate to the first atomic layer of their alloys with Pd while for Pd-Cu alloys the degree of segregation is small but occurs mainly on the second atomic plane. The short-range order of the surfaces is addressed by studying the relative abundance of different compositions of nearest neighbor triangles on the (111) surfaces. The presence of triangles containing only atoms of one element is found to be suppressed by the short-range order. This result is shown to follow from the enhancement for these alloys of nearest neighbor pairs of atoms of different types.

15231 **Surface chemistry of thin palladium films.** Neiman, D.L.; Koel, B.E. (Univ. of Colorado, Boulder, CO (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

The properties of Pd monolayers on several transition metal substrates are dramatically different from the surface properties of bulk Pd single crystals. The changes include a large rehybridization of the Pd atoms to a noble metal electronic configuration and a concomitant reduction in CO and H/sub 2/ chemisorption bond strengths. The authors present high temperature programmed desorption (TPD) studies of CO, NO, H/sub 2/, and C/sub 2/H/sub 4/ chemisorption on thin epitaxial Pd films on Nb(110). The authors' results confirm for all of these gases a large reduction in the chemisorption bond energy for adsorption on Pd thin (<2 ML) films. The authors' TPD results for CO, which give a CO binding energy of about 10 kcal/mole, confirm previous UPS studies which show that a Pd monolayer forms only a weak chemisorption bond to CO. Thicker Pd films (> 5 ML) have CO TPD spectra that agree qualitatively with previous studies on Pd(111) single crystals, where the CO binding energy is about 30 kcal/mole. These results for Pd/Nb(110) are discussed with respect to recent work on related systems involving thin Pd films on other transition metal substrates.

15232 **Oxygen adsorption on and oxidation of NiAl surfaces.** Zehner, D.M.; Gruzalski, G.R. (Oak Ridge Nat. Lab., Oak Ridge, TN (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Oxygen adsorption on the eventual oxidation of the (100), (110), and (111) surfaces of NiAl was studied extensively using a variety of surface sensitive techniques. While the initial rate of uptake at 22°C varied significantly with orientation and surface composition, in all cases it was possible to form an overlayer region containing the equivalent of several monolayers of oxygen. No ordered overlayers were observed. Information about the chemical bonding was obtained from changes in core-level binding energies. Examination of the Al 2p region showed evidence for two different oxide environments, depending on surface treatment. Comparison of these results with those for both Ni and Al clearly shows effect due to alloying.

15233 **The characterization of thin platinum films on alumina.** Altman, E.I.; Gorte, R.J. (Univ. of Pennsylvania, Philadelphia, PA (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

Industrial metal catalysts are usually in the form of small metal particles supported on a porous oxide. The typical size of these metal particles ranges between 1.0 and 10.0 nm and it is well known that the particle size and the oxide substrate can affect the catalytic properties of the metal for some important reactions. Previous work with adsorption on small particles has indicated that desorption temperatures and the ability to dissociate CO can also be affected by the particle size. To further investigate these size and substrate effects, the authors have examined the adsorption properties of several simple gases on small Pt particles supported on alumina using temperature programmed desorption (TPD). The author show that the desorption curves for CO, H/sub 2/, and NO on these particles are very similar to curves measured on single crystals. The details of sample preparation and characterization have been described previously. Samples were prepared by vapor depositing Pt onto an alumina substrate which was formed by exposing an Al film to O/sub 2/. Auger electron spectroscopy was used to monitor surface cleanliness and to characterize the growth of the Pt on the substrate. As reported previously, the Pt grew in a layer-by-layer manner at both 90K and 300K. This film aggregated into clusters when the sample was heated above 650K and the average size of these particles could be determined from the saturation coverage of CO and from the quantity of metal deposited, as measured using a film thickness monitor. All adsorption measurements reported in this paper were made on samples heated above 650K.

15234 **Characterization of a AG monolayer on PT by surface enhanced Raman scattering.** Miragliotta, J.; Furtak, T.E. (Colorado School of Mines, Golden, CO (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

The authors report the results of a surface enhanced Raman scattering investigation of a Ag monolayer (ML) electrochemically deposited on a Pt substrate. The poor electromagnetic enhancing properties of this surface insure that the observed Raman scattering intensity is short-range in origin, arising from an electronic resonant process between the surface adatom and the probe molecule. Raman spectra showed the probe molecule, pyridine, to be bound to an electron-deficient Ag site. This supports earlier vacuum studies of the Ag/Pt surface which reported an electron transfer from the Ag ML into the Pt substrate leaving a partial positive charge in the ML. The transfer is due to the work function difference between Ag and Pt.

15235 **Adsorption and reaction on thin metal overlayers.** Berlowitz, P.J.; Peden, C.H.F.; Goodman, D.W. (Sandia Nat. Labs., Albuquerque, NM (US));. pp v of Physical and chemical properties of thin metal overlayers and allow surfaces. Zehner, D.M.; Goodman, D.W. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612128—).

From Materials Research Society symposium on physical and chemical properties of thin metal overlayers and alloy surfaces; Boston, MA, USA (3 Dec 1986).

These studies have addressed the adsorption of CO on very thin (submonolayer to multilayer) deposits of Cu, Ni, Pd, and Fe on single crystals of Ru and W. The kinetics of the methanation, ethane hydrogenolysis, and cyclohexane dehydrogenation reactions have also been measured over these model bimetallic catalysts. Temperature programmed desorption (TPD) spectra of CO at submonolayer coverages reveal new desorption features which have significantly perturbed peak maxima from those observed on the bulk metals, indicating the unique character of these monolayer metallic films. This behavior has been correlated with LEED, ARUPS, work function, and kinetic measurements.

15236 **Nucleation of allotropic phases during pulsed laser annealing of manganese.** Perepezko, J.H.; Follstaedt, D.M.; Peercy, P.S. (Univ. of Wisconsin, Madison, WI (US));. pp v of Beam-solid interactions and phase transformations. Kurz, H.; Olson, G.L.; Poate, J.M. Pittsburgh, PA; Materials Research Society (1986). (CONF-8512143—).

From Beam-solid interactions and phase transformations; Boston, MA, USA (2 Dec 1985).

Manganese has four allotropes with an equilibrium melting point of the high temperature δ-phase at 1517 K and calculated metastable melting points for the γ, B and α phases at 1501 K, 1481 K and 1395 K, respectively. The authors' observations for Mn irradiated with a pulsed laser and supporting estimates of maximum allotropic transition rates indicate that transformations between allotropes are suppressed during heating with — 25 ns laser pulses, as well as during subsequent cooling. Upon pulsed heating of α-Mn to the melt threshold, the melt is undercooled 122 K below the δ-Mn melting point. For incident laser pulse energy densities near the melting threshold, resolidification involves regrowth of α-Mn from the substrate. At energy densities well above threshold, the γ-Mn phase forms by separate nucleation and growth from the undercooled melt, and is retained upon rapid solidification. From these results and analyses, the authors conclude that significant melt undercooling, which may exceed 100 K, can occur during pulsed laser melting of metallic crystals and that the resulting crystalline structure is determined by both thermodynamics and nucleation kinetics.

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REFER ALSO TO CITATION(S) 14166, 14166, 14358, 14712, 14946, 15024, 15083, 15083, 15198, 15402, 15402, 15444, 15564, 15646, 15646, 15647, 15647, 15650, 15706, 15724, 15726, 15786, 16655, 16655, 16658, 16665, 16666

15237 **(CEA-CONF—9610) Moessbauer investigation of iron doped YBa/sub 2/Cu/sub 3/O/sub 7-δ/.** Dalmas de Reotier, P.; Yaouanc, A.; Vulliet, P.; Chaudouet, P.; Garcon, S.; Senateur, J.P.; Weiss, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Universite Joseph Fourier, 38 - Grenoble (FR); INPG/ENSPG, 38 - Saint-Martin-d'Heres (FR)). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756415/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

We have recorded /sup 57/Fe Moessbauer spectra of YBa/sub 2/(Cu/sub 94/Fe/sub 06/)/sub 3/O/sub 7-δ/ uniaxially oriented powder. Additional measurements have been made on YBa/sub 2/(Cu/sub 99/Fe/sub 01/)/sub 3/O/sub 7-δ/ and YBa/sub 2/(Cu/sub 99/Fe/sub 01/)/sub 3/O/sub 6/ powder. The analysis shows that the iron atoms substitute Cu1 (in the oxygen chain) and that the main axis of the electric field gradient (EFG) is in the c-plane.

15238 **(CEA-CONF—9612) Rare-earth valency and electric field gradient in Eu, Gd and Yb based high T/sub c/ superconductors.** Dalmas de Reotier, P.; Vulliet, P.; Yaouanc, A.; Chaudouet, P.; Garcon, S.; Senateur, J.P.; Weiss, F.; Asch, L.; Kalvius, G.M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; INPG/ENSPG, 38 - Grenoble (FR); Technische Univ. Muenchen, Garching (DE). Fachbereich Physik). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756417/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

From Moessbauer measurements on /sup 155/Gd and /sup 151/Eu in REBa/sub 2/ Cu/sub 3/O/sub 7-δ/, we have obtained an estimation of the second order crystal electric field (CEF) parameters at the rare earth site. A comparison of the temperature dependence of the measured electric field gradient (EFG) in EuBa/sub /2 Cu/sub 3/O/sub 7/ and EuBa/sub 2/ Cu/sub 3/O/sub 6/ shows that the spin-orbit coupling is much stronger in the O/sub 6/ than in the O/sub 7/ compound. /sup 170/Yb Moessbauer measurements give some information on the EFG due to the 4f electrons. 10% substitution of Ba by Eu almost completely destroy superconductivity. A /sup 151/Eu measurement on this compound shows that the valency of Eu is 3+ at the Ba site and that the EFG is about the same at the Ba and the RE site. This is confirmed by a /sup 133/Ba perturbed angular correlation (PAC) measurement. From the three Moessbauer probes we get a Debye temperature sum mass/sub D/ ≃ 270 (15) K for the O/sub 7/ compounds and EuBa/sub 2/Cu/sub 3/O/sub 6/.

15239 **(CEA-CONF—9613) Evidence of a first order phase transition in YBa/sub 2/Cu/sub 3/O/sub 6.9/ at T=230 K.** Calemczuk, R.; Bonjour, E.; Henry, J.Y.; Forro, L.; Ayache, C.; Jurgens, M.J.M.; Rossat-Mignod, J.; Burlet, P.; Couach, M.; Khoder, A.F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756418/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

In order to bring more information on the behaviour of high T/sub c/ superconductors, in the normal phase, we have undertaken detailed low frequency acoustic, specific heat and resistivity ex-

periments between T/sub c/ and room temperature. The obtained results presented in this paper, allow us to conclude that YBa/sub 2/Cu/sub 3/O/sub 6.9/ undergoes a first order phase transition in the 200-240 K temperature range. The three above mentioned properties display clear anomalies which are not observed on a non-superconducting sample YBa/sub 2/Cu/sub 3/O/sub 6.0/.

15240 **(CEA-CONF—9616) Superstructure of the superconductor Bi/sub 2/Sr/sub 2/CaCu/sub 2/O/sub 8/ by high resolution electron microscopy.** Hewat, E.A.; Capponi, J.J.; Chaillout, C.; Hodeau, J.L.; Marezio, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR). Inst. de Recherche Technologique et de Developpement Industriel; Centre National de la Recherche Scientifique, 38 - Grenoble (FR)). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756651/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

The superstructure of the high Tc superconducting oxide Bi/sub 2/Sr/sub 2/CaCu/sub 2/0/sub 8/ has been studied by high resolution electron microscopy. Waves of distortion along the b-axis give an incommensurate superlattice slightly larger or smaller than 5√2a /sub p/ (a/sub p/ = perovskite unit cell). The building blocks along the b-axis are 4, 5 and 6 times √2a/sub p//2. The incommensurate superlattice is composed of approximately periodic combinations of these building blocks. The symmetry of three major projections are P/sub gm/ (or possibly P/sub gg/), C/sub mm/ and C/sub mm/ for the ideal superlattice with b=5√ 2a/sub p/. These projections correspond to the space groups Pcnn and Pmnn respectively.

15241 **(CEA-CONF—9617) Study of the oxygen core deficiency in a single crystal of YBa/sub 2/Cu/sub 3/O/sub 6.8/ by AC susceptibility.** Couach, M.; Khoder, A.F.; Henry, J.Y.; Ayache, C.; Bonjour, E.; Calemczuk, R.; Salce, B.; Barbara, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR). Dept. de Recherche Fondamentale; Centre National de la Recherche Scientifique, 38 - Grenoble (FR). Lab. Louis-Neel). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756652/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

AC Susceptibility studies of YBa/sub 2/Cu/sub 3/O/sub 7-δ/ single crystals, have been performed with Hac fields parallel and perpendicular to the (a,b) basal plane of the structure. The analysis of the obtained results gives evidence for a plate-like structure in which the oxygen deficiencies increase when going to the sample core. Further results are observed and discussed in relation with the existence of twin domains.

15242 **(CEA-CONF—9618) Transport properties of a YBa/sub 2/Cu/sub 3/O/sub 7-δ/ single crystal.** Forro, L.; Raki, M.; Ayache, C.; Stamp, P.C.E.; Henry, J.Y.; Rossat-Mignot, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756421/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

In the present communication, we gather several transport properties measured on the same single crystal of YBa/sub 2/Cu/sub 3/O/sub 7-δ/ (T/sub c/ ≅ 84 K). The strong anisotropy of this compound is confirmed for the resistivity, the Hall coefficient and the upper critical-field. This excludes any description of the c-axis properties on the basis of band-calculations pictures. Instead we suggest that the CuO(2.3)/Y/CuO(2.3) sandwiches constitutes the basis of the electronic properties together with an effective resonant scattering.

15243 **(CEA-CONF—9619) Low temperature thermal conductivity of YBa/sub 2/Cu/sub 3/O/sub 6+x/ (x=0.1 - > 0.9) compounds.** Salce, B.; Calamszuk, R.; Ayache, C.; Bonjour, E.; Henry, J.Y.; Raki, M.; Forro, L.; Couach, M.; Khoder, A.F. and others. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756422/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

Thermal conductivity measurements of YBa/sub 2/Cu/sub 3/O/sub 6+x/ have been performed on three superconducting samples (x ≧ 0.55) and an insulating one (x <{similar←to} 0.1) in the temperature range 100 mK-150 K. A quasilinear temperature dependent contribution was evidenced in the superconducting samples which was missing in the insulating one. The origin of this contribution, discussed with reference to specific heat data carried out on the same samples, is attributed to scattering of phonons by twins rather than to normal charge carriers.

15244 **(CEA-CONF—9621) HREM study of Bi-oxide based high T/sub c/ superconductors.** Hewat, E.A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1988. 17p. (CONF-8805246—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756423/JAW.

From Annual Meeting of the French Society of Electron Microscopy; Lille, France (16 May 1988).

A HREM study of the superstructure and structural defects in Bi/sub 2-x/Pb/sub x/Sr/sub 2/CaCu/sub 2/O/sub 8/ and Bi/sub 2-x/Pb/sub x/(SrCa)/sub 2/CuO/sub 6/ (for x=0 and x=0.4) is presented. The superstructures are shown to involve waves of distortion along the b-axis. These waves are locked on to the lattice positions so that they have a local wave length of 4,5,6,7 or 8 times the basic unit cell. The superstructures are composed of roughly periodic combinations of these basic building blocks (waves). The lead doped superconductors show a less pronounced but more complicated superstructure along b where two distinct periodicities close to 4 and 7 times the basic unit cell predominate. In each of the compounds studied the superstructure, in the better ordered crystals, is shown to be commensurate with a unit cell between 5 and 23 times the basic unit cell. The superstructure in Bi/sub 2-x/Pb/sub x/Sr/sub 2/CaCu/sub 2/O/sub 8/ is orthorhombic where as the superstructure in Bi/sub 2-x/Pb/sub x/(SrCa)/sub 2/CuO/sub 6/ is monoclinic. All these superconductors have a low "twin" density (ie density of 90/sup 0/ twist boundaries). They exhibit many dislocations and dislocation arrays associated with the weak bonding between BiO planes. They also form non-stoichiometric stacking faults with local changes in the c-axis spacing between layers.

15245 **(CONF-881155—37) Reinforcement/matrix interaction in SiC fiber-reinforced Ni_3Al matrix composites.** Yang, J.-M.; Kao, W.H.; Liu, C.T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006041/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

The interfacial reaction characteristics of two different types of SiC fibers with Ni_3Al (Ni-Al-Cr-Zr-B) matrix have been investigated. The microstructure and chemical compositions across the reaction zones have been analyzed quantitatively using microscopy and electron probe microanalysis. In both types of SiC/Ni_3Al composites, it was found that Ni was the dominant diffusing species responsible for the overall reaction. The C-rich layer outside the SCS-6 fiber provided an incubation period, but could not stop the inward diffusion of Ni. It could, however, effectively stop the diffusion of Al, Zr, and Cr. No significant increase in reaction zone thickness after exposure at temperatures below 900{degree}C for up to 100 hours was observed. When the C-rich layer was depleted, a rapid increase in reaction zone thickness and the formation of

multilayer reaction products occurred. In the case of Sigma/Ni_3Al composite, extensive reaction between the fiber and the matrix occurred at all the temperatures studied. Diffusion barrier coating for both types of fibers is required to develop nickel aluminide matrix composites. 17 refs., 3 figs.

15246 **(CONF-881155—38) Microstructural characterization of α-Al_2O_3 implanted with iron.** Sklad, P.S.; McCallum, J.D.; Pennycook, S.J.; McHargue, C.J.; White, C.W.; Perez, A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006037/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

The microstructural and compositional changes produced in the near surface region of single crystals of α-Al_2O_3 by ion-implantation with iron have been investigated by a number of complementary techniques, including Rutherford backscattering spectroscopy (RBS), conversion-electron Moessbauer spectroscopy (CEMS), analytical electron microscopy (AEM), and scanning transmission electron microscopy (STEM). Iron precipitates, 1 to 3 nm in diameter, have been identified in as-implanted material at depths corresponding to the peak in the deposited iron concentration profile. The same techniques have been used to monitor the redistribution of iron and the corresponding changes in valence state during post-implantation annealing. Electron microscopy has been to correlate RSB and CEMS results with the microstructural development. 9 refs., 4 figs., 1 tab.

15247 **(CONF-881155—39) The influence of thickness and wavelength on the mechanical properties of a compositionally modulated ceramic thin film.** Oliver, W.C.; List, F.A.; McKee, R.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006033/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

The hardness and modulus of thin (<1 μm) ceramic films have been investigated using the differential mechanical properties microprobe (DMPM). The DMPM consists of a computer controlled ultra-low load indentation system with a special system that allows the elastic stiffness of the contact to be determined continuously during the indentation process. The films were deposited in a molecular beam epitaxy (MBE) system utilizing unique high temperature effusion cells. Two specimens have been studied. The fist is a wedge shaped layer of amorphous Al_2O_3 on a silicon substrate. The thickness of the layer varies from 0 to 990 nm at the two extreme sides of a 3 in. silicon wafer. The effect of layer thickness on the hardness and modulus as measured with the DMPM has been quantified for this system. The second specimen is made up of 38 repetitions of alternating layers of crystalline TiO_2 and amorphous Al_2O_3. The wavelength of the composition modulation and the thickness of the film varies uniformly from 0 to 38 nm and from 0 to 1460 nm respectively across the 3 in. diameter of the silicon substrate. 17 refs., 5 figs.

15248 **(CONF-8808187—1) Oxygen diffusion in YBa_2Cu_3O/sub 7-δ/.** Routbort, J.L.; Rothman, S.J.; Nowicki, L.J.; Goretta, K.C. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005831/JAW.

From AUSTCERAM '88: international conference on ceramics; Sidney, Australia (20 Aug 1988).

The tracer diffusion coefficient of ^{18}O in the 90 K superconducting oxide, YBa_2Cu_3O/sub 7-δ/, in the temperature range of 300 to 600{degree}C was measured using the SIMS technique. An "activation energy" of 0.95 eV was obtained which we believe represents the temperature dependence of volume diffusion. Techniques to measure more accurately diffusion at higher temperature are being devised and diffusion experiments on single crystals are in progress. 14 refs., 5 figs.

15249 **(CONF-8810278—1) AES [auger electron spectroscopy] and EELS [electron energy loss spectroscopy] analysis of TlBaCaCuO/sub x/ thin films at 300 K and at 100 K.** Nelson, A.J.; Swartzlander, A.; Kazmerski, L.L.; Kang, J.H.; Kampwirth, R.T.; Gray, K.E. (Argonne National Lab., IL (USA); Solar Energy Research Inst., Golden, CO (USA)). Oct 1988. Contract W-31109-ENG-38;AC02-83CH10093. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004271/JAW.

From Topical conference on high temperature superconductors; Atlanta, GA, USA (3 Oct 1988).

Auger electron spectroscopy line-shape analysis of the Tl(NOO), Ba(MNN), Ca(LMM), Cu(LMM) and O(KLL) peaks has been performed in conjunction with electron energy loss spectroscopy (EELS) on magnetron sputter deposited TlBaCaCuO/sub x/ thin films exhibiting a superconducting onset at 110K with zero resistance at 96K. AES and EELS analyses were performed at 300K and at 100K. Changes in the Auger line shapes and in the EELS spectra as the temperature is lowered below the critical point are related to changes in the electronic structure of states in the valence band (VB). Bulk and surface plasmon peaks are identified in the EELS spectra along with features due to core level transitions. Electron beam and ion beam induced effects are also addressed. 13 refs., 3 figs., 1 tab.

15250 **(DOE/CE/90041—1) Tool wear modelling/life prediction: Final report for the period September 1, 1986–February 29, 1988.** Kramer, B.M. (George Washington Univ., Washington, DC (USA)). Dec 1988. Contract AC02-86CE90041. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005818/JAW.

A calibrated analytical model of cutting tool wear has been developed to allow for the prediction of the wear rates of potential coatings for cutting tool materials. The model has been used to select coating compositions which may provide improved performance, as compared to existing titanium nitride based coatings. The model predicts that the wear resistance of the IVB nitrides will increase in the order TiN, ZrN and HfN. In addition, it predicts that the wear resistance of the binary nitride (Ti,Hf)N will be greater than that of either of the component mononitrides under the cutting conditions which are commonly used in the machining of steel with high speed steel tooling. 7 refs., 6 figs.

15251 **(DOE/ER/45097—T4) Defect clustering and related properties of oxides: Annual technical progress report.** Cohen, J.B.; Engelhart, F.C.; Ellis, D.E.; Mason, T.O. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). 6 Jan 1989. Contract FG02-84ER45097. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006620/JAW.

This report discusses research programs on the crystal structure of different metal oxides. Electrical properties of some oxides are also discussed. (LSP)

15252 **(DOE/ER/45307—T1) Grain boundary nonstoichiometry in multicomponent ceramics: Technical progress report.** Chiang, Yet-Ming. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jan 1989. Contract FG02-87ER45307. 3p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006109/JAW.

The objectives of this research program are to investigate the relationships between lattice and grain boundary defect chemistry in multicomponent, nonstoichometric oxides, and their effects on grain boundary physical properties. Systems of current interest include titanates (TiO_2, $SrTiO_3$ and $BaTiO_3$) and cuprate superconductors (primarily La/sub 2-x/Sr/sub x/CuO_4 and YBa_2Cu_3O/sub 7-y/).

15253 **(DOE/ER/45312—T1) Alumina reinforced tetragonal zirconia (TZP) composites: [Progress report].** Shetty, D.K. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). 1989. Contract FG02-87ER45312. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89006467/JAW.

This report presents brief summaries of progress in each of the three areas listed below. Studies of Interfacial Bonding and Sliding Friction in Ceramic-Matrix Composites, Fabrication and Characterization of Al_2O_3-Reinforced Zirconia Composites, and Application of Electrical-Mechanical Analog to Composites. (JL)

15254 **(DOE/FTR—9006291) [Symposium on superconductivity, Tokyo, Japan, and visits to research laboratories of Furukawa Electric Co. and Nippon Steel Corp., Yokohama, May 30--June 8, 1988]: Foreign trip report.** Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 16 Jun 1988. Contract AC02-76CH00016. 8p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006291/JAW.

This report highlights the symposium, particularly emphasizing the Japanese work in the high temperature oxide superconductors, and assesses the research and development efforts on superconducting materials at two actively involved companies, Nippon Steel Corp. and Furukawa Electric Co. This also includes the traveler's personal impression, which was gained through his discussion with a number of his Japanese acquaintances, of the direction of their effort on development and applications of superconducting materials.

15255 **(ENEA-RT-COMB—88-5) Superconductive ceramics obtained with sol gel method.** Arcangeli, A.; Mosci, A.; Nardi, A.; Vatteroni, R.; Zondini, C.; Fava, R. (ENEA, Casaccia (Italy). Centro Ricerche Energia; AGIP SpA, Bologna (Italy)). (ENEA, Rome (Italy)). 1988. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705434/JAW.

Several sol gel routes have been considered, studied and developed to produce large quantities of granulates which can be processed to obtain ceramics having good superconducting characteristics. In the considered process a mixture of commercial nitrates is atomized, at room temperature, in a solution 1:1 of Primene JMT and Benzene and a pale blue gel of the starting elements is suddently formed. The granulates obtained are free flowing, very reactive and well suited for pressing. For their intrinsic characteristics they could be very good precursors for the production of large quantities of superconductive ceramics in different forms. The precipitated gel is dried, calcinated, pressed in the form of cylindrical pellets which are sintered up to 960 degrees C. No griding or different thermal treatments are needed. The sintered material has low electric resistence, shows a clear Meissner effect and has a transition temperature of between 91 and 95 K.

15256 **(FRCEA-R—40) Positron annihilation at defects in sintered high Tc perovskite superconductors.** Corbel, C.; Bernede, P.; Pascard, H.; Rullier-Albenque, F.; Kormann, R.; Marucco, J.F. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Ecole Polytechnique, 91 - Palaiseau (France); Thomson-CSF, Domaine de Corbeville, 91 - Orsay (FR); Paris-11 Univ., 91 - Orsay (France)). (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756439/JAW.

We report positron lifetime measurements in sintered superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/ and GdBa/sub 2/Cu/sub 3/O/sub 7-x/ oxides. It is shown that the thermal behaviour of the positron lifetime spectra strongly depends on the preparation of the ceramics. A lifetime of 190+-3 ps is attributed to oxygen deficient regions. Two lifetimes of 251+-7 ps and 225+-5 ps are attributed to a cation vacancy presenting a temperature dependent atomic arrangement. The lifetime transition (251 -> 225 ps) occurs during decreases in temperature across the resistivity superconducting transition. This lifetime change indicates that the volume of the cation vacancy decreases in the superconducting state.

15257 (IA—1440, pp 103-104) **Geometrical considerations in the structure of superconductors of the type M/sup (+3)/Ba/sub 2/Cu/sub 3/O/sub 6.5+δ/.** Feldstein, H.; Raizman, A.; Aharonovits, R.; Shaham, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15258 **(K/QT—188) A dynamic flow-weighted pore size distribution test.** Fain, D.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400. 18p. (CONF-8807110—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006191/JAW.

From Fine Particle Society meeting; Santa Clara, CA, USA (19 Jul 1988).

An accurately measured pore size distribution can be important in evaluating the characteristics and functional performance of a porous material. Pore size distributions are usually measured by evaluating the change in volume of a material deposited in the porous material under varying conditions that can be related to a pore size. The distribution of volume may or may not be easily related to other properties that are functions of other moments of the pore size distribution. A method has been developed for measuring the fraction of the flow of an inert gas through various pore size channels in a porous material. The measurement is accomplished by using a mixture of an inert gas such as nitrogen and a condensable gas such as carbon tetrachloride. The test begins with the partial pressure of the condensable gas near unity. The condensable gas will fill all of the pores of the material and there is no flow of nitrogen through the material. As the pressure of the mixture is incrementally decreased, a range of pore sizes is opened and the flow of nitrogen increases. These data provide the accumulated total flow of nitrogen as a function of pore size. This paper gives the theory associated with the test, describes the apparatus for making the measurements, and shows some results. 2 refs., 6 figs., 1 tab.

15259 **(KFK—4482) X-ray investigations of ceramic high-T/sub c/ superconductors under high pressure.** Fietz, W.H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Nov 1988. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756817/JAW.

Ceramic high-T/sub c/ materials have been investigated in a new experimental setup, which has been designed for X-ray investigations under high pressure. The superconducting material La/sub 1.8/Sr/sub 0.2/CuO/sub 4/ shows a uniform reduction of the lattice parameters up to pressures of 170 kbar. The bulk modulus of La/sub 1/./sub 8/Sr/sub 0.2/CuO/sub 4/ was found to be 1700 kbar. In contrast, YBa/sub 2/Cu/sub 3/O/sub 7/ shows an asymmetry in the reduction of the lattice parameters, which may be explained by an excessive decrease of the lattice parameter in the direction of the b- or c-axis. The orthorhombic phase is stable in the entire temperature range of 300 K to 15 K under ambient pressure. At higher pressures a pseudo-tetragonal phase may be reached, if we assume a preferential b-lattice parameter reduction. On the other hand, the obvious assumption of a preferential decrease of the c-lattice parameter leads to a preservation of the orthorhombic phase in the entire investigated pressure range. The bulk modulus of YBa/sub 2/Cu/sub 3/O/sub 7/ was found to be 1800 kbar.

15260 **(LA-UR—88-4059) Structure-property characterization of a shock-loaded boron carbide-aluminum cermet.** Blumenthal, W.R.; Gray, G.T. III. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 9p. (CONF-890324—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005455/JAW.

From 4. international conference on mechanical properties of materials at high rates of strain; Oxford, UK (20 Mar 1989).

Shock-recovery experiments were performed on a 65 vol % B_4C-Al cermet as a function of shock pressure. Samples were recovered largely intact due to the use of confinement and "soft-recovery" techniques. Post-shock examination by optical and transmission electron microscopy (TEM) showed the B_4C structure to

be unchanged up to 5 GPa, while the Al phase exhibited a high density of randomly distributed dislocations. After a shock of 10.6 GPa some of the B_4C grains displayed dislocation debris, but the majority showed no evidence of plastic deformation. Uniaxial compression testing of the unshocked cermet showed a 24% increase in strength from 1.94 GPa to 2.4 GPa with an increase in strain rate from 10/sup {minus}3/ s/sup {minus}1/ to 10^3 s/sup {minus}1/.

15261 (LA-UR—89-258) Electron spectroscopy studies of high temperature superconductors: Y/sub 1{minus}x/Pr/sub x/Ba_2Cu_3O/sub 7{minus}δ/. Kang, J.S.; Allen, J.W.; Lee, B.W.; Maple, M.B.; Shen, Z.X.; Yeh, J.J.; Ellis, W.P.; Spicer, W.E.; Lindau, I. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 13p. (CONF-8810255—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006554/JAW.

From International symposium on the electronic structure of High {Tc} superconductors; Rome, Italy (5 Oct 1988).

We itemize our previous work on high T/sub c/ superconductors, and describe more fully the results of an electron spectroscopy study and impurity Anderson Hamiltonian analysis of the Pr 4f spectrum of Y/sub 1{minus}x/Pr/sub x/Ba_2Cu_3O/sub 7{minus}δ/, a system in which superconductivity is quenched as x increases. It has been speculated that Pr has valence 4+, resulting in extra charge in the Cu-O planes, and causing T/sub c/-suppression. We find that the Pr valence is close to 3+ for all x but that there is extensive Pr 4f hybridization with other valence band states. The Cu valence is essentially unchanged with x. From these findings, we speculate that Pr 4f hybridization with other valence band states has enabled Pr spin fluctuations to cause the T/sub c/-suppression. 41 refs., 4 figs.

15262 (LBL—25846) The surface chemistry of vanadium oxide catalysts. Lewis, K.B. Jr. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 153p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007071/JAW.

The surface chemistry of vanadium oxide catalysts was studied using uhv surface techniques and catalytic experiments at atmospheric pressure. In uhv, vanadium oxide films were grown on single crystal vanadium, Au(111), and Au foil substrates. Silica supported V_2O_5 was used in the catalytic experiments. Auger electron spectroscopy and low energy electron spectroscopy revealed temperature dependent surface segregation of contaminants on the V(110) surface. Temperature programmed desorption revealed both a surface and a bulk desorption state for hydrogen, and two desorption states for potassium on V(110). Recrystallized foils containing large grains with a V(100) orientation were also examined. Vanadium oxides films grown on a Au(111) substrate were ordered and exhibited a ($\sqrt{3}$ {times} $\sqrt{3}$) R30 {degree} LEED pattern. The growth mode and preparation of these films is discussed. The structure and Auger spectrum of the films were consistent with a V_2O_3 surface. The TPD of hydrogen, ethanol, and ethylene were examined on this surface. Polycrystalline V_2O_5 supported on Au foil was also studied An oxidized surface was maintained through the facile surface segregation of lattice above 750 K. Two water desorption peaks were observed after the adsorption of predissociated hydrogen. CO, CO_2, and C_2H_4 were the principle desorption products after ethanol adsorption in uhv and at atmospheric pressure. The partial oxidation of methane and ethanol over V_2O_5 {minus} SiO_2 was investigated. Methane oxidation with N_2O proceeded very slowly, however activation energies and rate laws were determined. Ethanol oxidation with O_2 was more rapid. Catalyst dispersions were measured using irreversible oxygen uptake following reduction at 641 K. Ethanol partial oxidation was structure insensitive. 137 refs., 58 figs., 3 tabs.

15263 (LBL—26107) Some structural features of high-T/sub c/ superconductors. Jou, Chengfong Joseph. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 86p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006667/JAW.

Some structural features of high-T/sub c/ oxide superconductors including Tl-Ca-Ba-Cu-O, Bi-Ca-Sr-Cu-O, Y-Ba-Cu-O, La-(Ba,Sr,Ca)-Cu-O, Ba-K-Bi-O and Ba-Pb-Bi-O systems are systematically examined. Based on common features in these systems in addition to CuO_2 layers, an imperfect macro-resonance-cell (MRC) description is proposed that provides a basis for qualitatively understanding the superconductivity in these systems. It is proposed that boundary layer coupling plays a major role in determining the different T/sub c/ values of these systems. The YBCO system is particularly interesting for its unusual linear chain structure at the boundary layer. This chain structure originating from oxygen ordering on the basal plane also results in micro-twinned morphology in orthorhombic phase. A nucleation-and-growth mechanism for this twin formation associated with the second order phase transformation is proposed. An oxygen-depleted twin boundary model is also discussed, which explains why stoichiometric, $YBa_2Cu_3O_7$, is difficult to achieve. 125 refs., 15 figs., 4 tabs.

15264 (N—89-12626, pp 327-340) Rolling contact fatigue life of zirconium and molybdenum nitride sputter plated AMS 5749 bearing steel. Thom, R.L.; Dolan, F.J. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Hardened AMS 5749 (Latrobes BG42) bearing steel test specimens were reactively sputter plated with zirconium nitride or molybdenum nitride to thicknesses of 0.5 to 1.0 microns. The test specimens were evaluated for rolling contact fatigue (RCF) resistance at stresses of both 5.42 GPa (786 ksi) and 4.04 GPa (586 ksi) using a ball on rod test setup. Significant improvements in RCF lives of over 100 percent were obtained for coated test specimens over the baseline uncoated AMS 5749. These results indicate improvements that can be made to bearings using reactive sputter plating methods.

15265 (N—89-12626, pp 366-376) Surface modification for wear resistance in a liquid oxygen turbopump environment. Ng, L.; Naerheim, Y. (Rockwell International Science Center, Thousand Oaks, CA (USA)). Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Bearing elements for the Space Shuttle Main Engine oxidizer turbopumps operate in the low viscosity environments of liquid oxygen, which results in an operating condition of poor lubrication. High transient axial loads and high coefficient of friction due to lack of lubricant in the high pressure oxidizer turbopump bearings has resulted in surface wear. Hard coatings were utilized to reduce the coefficient of friction and increase the wear resistance of steels. In this study, three bearing alloys (AMS 5618 (VIM-VAR), AMS 5900, and AMS 6491) were coated with TiN or thin-dense-Cr for evaluating the effects of surface modification on wear. Testing was performed in a cone-three-ball tester modified to provide both rolling and sliding friction that simulates operating conditions. Also, a liquid oxygen environment was used to simulate the operating environment. Test results including detailed Scanning Electron Microscopy (SEM), Electron Microscopy for Chemical Analysis (ESCA), and optical analysis will be presented.

15266 (N—89-12876, pp 415-434) Study on thermal barrier coatings including thermal expansion mismatch and bond coat oxidation. Chang, G.C.; Phucharoen, W.; Miller, R.A. (Cleveland State Univ., OH (USA)). Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The present investigation deals with a plasma-sprayed thermal barrier coating (TBC) intended for high temperature applications to advanced gas turbine blades. Typically, this type of coating system consists of a zirconia-yttria ceramic layer with a nickel-chromium-aluminum bond coat on a superalloy substrate. The problem on hand is a complex one due to the fact that bond coat oxidation and thermal mismatch occur in the TBC. Cracking in the TBC has also been experimentally illustrated. A clearer understanding of the mechanical behavior of the TBC is investigated. The stress states in a model thermal barrier coating as it cools down in air is studied. The powerful finite element method was utilized to model

a coating cylindrical specimen. Four successively refined finite element models were developed. Some results obtained using the first two models have been reported previously. The major accomplishment is the successful development of an elastic TBC finite element model known as TBCG with interface geometry between the ceramic layer and the bond coat. An equally important milestone is the near-completion of the new elastic-plastic TBC finite element model called TBCGEP which yielded initial results. Representative results are presented.

15267 (N—89-12876, pp 435-445) **Thermal barrier coating life prediction model development.** Strangman, T.E.; Neumann, J.F.; Liu, A. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Thermal barrier coatings (TBCs) for turbine airfoils in high-performance engines represent an advanced materials technology with both performance and durability benefits. The foremost TBC benefit is the reduction of heat transferred into air-cooled components, which yields performance and durability benefits. This program focuses on predicting the lives of two types of strain-tolerant and oxidation-resistant TBC systems that are produced by commercial coating suppliers to the gas turbine industry. The plasma-sprayed TBC system, composed of a low-pressure plasma-spray (LPPS) or an argon shrouded plasma-spray (ASPS) applied oxidation resistant NiCrAlY (or CoNiCrAlY) bond coating and an air-plasma-sprayed yttria (8 percent) partially stabilized zirconia insulative layer, is applied by Chromalloy, Klock, and Union Carbide. The second type of TBC is applied by the electron beam-physical vapor deposition (EB-PVD) process by Temescal.

15268 (N—89-12876, pp 447-467) **Thermal barrier coating life prediction model.** Pilsner, B.H.; Hillery, R.V.; McKnight, R.L.; Cook, T.S.; Kim, K.S.; Duderstadt, E.C. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objectives of this program are to determine the predominant modes of degradation of a plasma sprayed thermal barrier coating system, and then to develop and verify life prediction models accounting for these degradation modes. The program is divided into two phases, each consisting of several tasks. The work in Phase 1 is aimed at identifying the relative importance of the various failure modes, and developing and verifying life prediction model(s) for the predominant model for a thermal barrier coating system. Two possible predominant failure mechanisms being evaluated are bond coat oxidation and bond coat creep. The work in Phase 2 will develop design-capable, causal, life prediction models for thermomechanical and thermochemical failure modes, and for the exceptional conditions of foreign object damage and erosion.

15269 (N—89-12876, pp 469-483) **Thermal barrier coating life prediction model development.** Demasi, J.T.; Sheffler, K.D. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objective of this program is to establish a methodology to predict Thermal Barrier Coating (TBC) life on gas turbine engine components. The approach involves experimental life measurement coupled with analytical modeling of relevant degradation modes. The coating being studied is a flight qualified two layer system, designated PWA 264, consisting of a nominal ten mil layer of seven percent yttria partially stabilized zirconia plasma deposited over a nominal five mil layer of low pressure plasma deposited NiCoCrAlY. Thermal barrier coating degradation modes being investigated include: thermomechanical fatigue, oxidation, erosion, hot corrosion, and foreign object damage.

15270 (NUREG/CR—5266) **Examination of two 3M type 902F static eliminators.** Czajkowski, C. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle, Medical, Academic and Commercial Use Safety; Brookhaven National Lab., Upton, NY (USA)). Jan 1989. Contract AC02-76CH00016. 23p. (BNL-NUREG—52175). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89006444/JAW.

Various incidents of facility contamination by polonium-210 microspheres have occurred as a result of failures of static eliminators manufactured by the Minnesota Mining and Manufacturing Company (3M). A previously performed failure investigation by Brookhaven National Laboratory on six static eliminators concluded that non-uniform and imperfect microspheres have been produced and installed in the static eliminators. This report details the investigation of two type 902F static eliminators. It essentially confirms the prior report's conclusions that imperfect microspheres are being produced and that the epoxy binder material is subject to cracking even under ambient conditions. 2 refs., 17 figs.

15271 (NUREG/CR—5271) **Thermochemical properties of gibbsite, bayerite, boehmite, diaspore, and the aluminate ion between 0 and 350{degree}C.** Apps, J.A.; Neil, J.M.; Jun, C.H. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management; Lawrence Berkeley Lab., CA (USA)). Jan 1989. Contract AC03-76SF00098. 346p. (LBL—21482). NTIS, PC A15/MF A01 - GPO - OSTI. Order Number TI89006046/JAW.

A requirement for modelling the chemical behavior of groundwater in a nuclear waste repository is accurate thermodynamic data pertaining to the participating minerals and aqueous species. In particular, it is important that the thermodynamic properties of the aluminate ion be accurately determined, because most rock forming minerals in the earth's crust are aluminosilicates, and most groundwaters are neutral to slightly alkaline, where the aluminate ion is the predominant aluminum species in solution. Without a precise knowledge of the thermodynamic properties of the aluminate ion aluminosilicate mineral solubilities cannot be determined. The thermochemical properties of the aluminate ion have been determined from the solubilities of the aluminum hydroxides and oxyhydroxides in alkaline solutions between 20 and 350{degree}C. An internally consistent set of thermodynamic properties have been determined for gibbsite, boehmite, diaspore and corundum. The thermodynamic properties of bayerite have been provisionally estimated and a preliminary value for $\Delta G/sub\ f,\ 298/^{0}$ of nordstrandite has been determined. 205 refs., 17 figs., 25 tabs.

15272 (PB—89-128938/XAB) **Preparation and characterization of WC and cemented-carbide powders for hard metal production. Final report.** Manninen, H. (Helsinki Univ. of Technology, Espoo (Finland). Lab. of Materials Processing and Powder Metallurgy). 1988. 42p. (TKK-V-B—38). NTIS, PC E03/MF A01.

The aim of this work was to investigate the possibility of replacing cemented carbide powder with reclaimed powder in rock-drilling-grade cemented carbides. A comparison between powder characteristics, sintering behavior, and mechanical properties of sintered virgin and reclaimed cemented carbides was made. The most important and promising result was found from the real rock-drilling tests. In spite of the differences in powder characteristics and behavior during sintering, the reclaimed cemented carbide inserts had similar performance in drilling operation to virgin hard-metal inserts. Nor were there significant differences between different reclaimed/virgin blends. It was possible to drill about 130 meters with all inserts, which is a good result for the type of drill used. The authors used a hand-held drill in their tests, but the results might be different if a bigger type of drill were used.

15273 (PB—89-148332/XAB) **Design and construction of a state-of-the-art high-temperature tribometer. Final report.** Yellets, J.P.; Hsu, S.M.; Klaus, E.E. (National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (USA). Ceramics Div.). Sep 1988. 215p. (NIST/SP—755). NTIS, PC A10/MF A01.

Also available from Supt. of Docs as SN003-003-02913-1. Library of Congress catalog card no. 88-600579.

High-temperature ceramic tribology is one of the fastest-growing and least-understood areas in tribology. The need to understand the mechanisms of friction and wear for ceramic materials is critical. Ceramic materials are being utilized to tool development, bearing design, materials development for low-heat-rejection diesels, automotive gas turbines, Stirling engines, and aerospace applications. The development of a ceramics industry capable of manufacturing high-technology wear-resistant ceramics is essential in the United States, or the United States will lose a substantial market to an already rapidly growing foreign market.

15274 **(PB—89-148340/XAB) High-temperature superconductivity: abstracts of NIST (National Institute of Standards and Technology) publications, 1987-1988. Final report.** DeWeese, M.E.; Kamper, R.A.; Powell, R.M. (National Inst. of Standards and Technology (NEL), Boulder, CO (USA). Electromagnetic Technology Div.). Nov 1988. 37p. (NIST/SP—759). NTIS, PC A03/MF A01.

Also available from Supt. of Docs as SN003-003-02902-5. Library of Congress catalog card no. 88-600602.

The authors have collected abstracts from 61 papers published between March 1987 and May 1988 covering various aspects of superconductivity research. The work of nine divisions of the National Institute of Standards and Technology (formerly the National Bureau of Standards) in both Boulder, Colorado, and Gaithersburg, Maryland, is represented.

15275 **(PB—89-148357/XAB) Ceramic tribology: methodology and mechanisms of alumina wear. Final report.** Gates, R.S.; Hsu, S.M.; Klaus, E.E. (National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (USA). Ceramics Div.). Sep 1988. 231p. (NIST/SP—758). NTIS, PC A11/MF A01.

Also available from Supt. of Docs as SN003-003-02914-9. Library of Congress catalog card no. 88-600582.

The report describes a systematic study that has been conducted to develop methods for measuring the tribological properties of ceramic materials under concentrated contacts. Step-loading four-ball and ball-on-three-flat wear tests were developed to provide friction and wear characteristics of ceramic/lubricant combinations under various lubrication conditions. These measurement techniques now enable one to study the effect of different materials processing parameters, material microstructures, and different lubricants on the friction and wear performance of ceramics. Water was found to react with alumina in a wearing contact to produce lubricous products. A combination of x-ray diffraction and thermogravimetric analysis techniques were used to investigate the kinetics of alumina-water reactions.

15276 **(PB—89-148985/XAB) Vapor-phase deposition studies of phosphate esters on metal and ceramic surfaces. Final report.** Deckman, D.E.; Hsu, S.M.; Klaus, E.E. (National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (USA). Chemical Performance and Standards Group). Sep 1988. 37p. (NIST/SP—754). NTIS, PC A08/MF A01.

Also available from Supt. of Docs. as SN003-003-02912-2. Library of Congress catalog card no. 88-600578.

This study focuses on a novel means of lubrication for ceramics and metals at high temperatures; called vapor-phase lubrication. The deposition rate and mechanisms of tributyl phosphate ester and tricresyl phosphate ester were explored. A thermalgravimetric analyzer (TGA) was modified to measure the rate of surface-film formation of vapor phase deposition of lubricants on metal surfaces at elevated temperatures. Results from TGA studies showed that the vapor-deposition process was a complex function of substrate, time, and temperature. Tricresyl phosphate ester (TCP) and tributyl ester (TBP) were observed to produce similar amounts of film on stainless steel substrates. The observed order of metal activity was copper > stainless steel > nickel > platinum. Film formation on nickel was found to be much more rapid at 600 C than 700 C. Also, the concentration of oxygen present during deposition strongly influenced the amount of film formed. Scanning electron microscopy was conducted on TBP films formed on Si_3N_4, Al_2O_3, and alpha-SiC. The films produced contained globule and filamentous structures. The films on each ceramic were unique, demonstrating that vapor deposition is surface-sensitive on ceramic substrates. High-temperature friction testing was conducted on a TCP coated Al_2O_3 substrate. The coating reduced the friction level for alumina, thus demonstrating the potential of vapor lubrication for high-temperature lubrication of ceramics.

15277 **(PNL-SA—16168) High pressure Raman spectroscopy of TiO_2 thin films.** Hess, N.J.; Exarhos, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830;AM06-70RL02225. 11p. (CONF-890145—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006937/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

The pressure dependences of the Raman active modes in submicrometer films of the anatase and rutile crystalline phases of TiO_2 have been determined at pressures approaching 90 Kbar. Films investigated have been prepared by reactive sputter deposition and sol-gel techniques. Band frequency shifts as a function of applied pressure for the rutile phase are in agreement with measurements from single crystal samples. However, sol-gel films (anatase) exhibit larger frequency shifts than powder or single crystal samples, and do not undergo the expected pressure-induced phase transformation to the TiO_2-II phase. This anomalous pressure response is discussed in terms of the complex film microstructure evaluated from TEM cross-sectional measurements. 11 refs., 5 figs.

15278 **(PNL-SA—16174) High temperature Raman scattering from boron nitride coatings on resistively heated graphite substrates.** Exarhos, G.J.; Schaaf, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830;AM06-70RL02225. 14p. (CONF-890145—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006933/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

Raman spectra of the hexagonal phase of boron nitride to temperatures exceeding 2000{degree}C, have been recorded using a pulsed-excitation gated-detection method. Surface temperatures were determined during rapid sample heating from analysis of corrected Stokes/anit-Stokes intensity ratios and from shifts in the resonance frequency of the 1366 cm/sup {minus}1/ E/sub g/ mode. Successive spectra were acquired at time intervals as short as 33 msec corresponding to the pulse repetition frequency of the probe laser. Using this synchronous detection technique, the time evolution of graphite furnace temperature was determined from measured spectra. Results indicate nearly complete rejection of sample blackbody from the Raman scattered light at these high temperatures. A nearly linear relationship between the Eg resonance frequency and temperature was found. Phonon linewidths were also found to increase by a factor of three over this temperature range. 5 refs., 6 figs.

15279 **(UCRL—98955) Anion grain boundary diffusion in Cr_2O_3 and Cr_2O_3-0.09 weight percent Y_2O_3.** King, W.E.; Park, J.H. (Lawrence Livermore National Lab., CA (USA); Argonne National Lab., IL (USA)). Jun 1988. Contract W-7405-ENG-48;W-31109-ENG-38. 7p. (CONF-880408—45). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006281/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, United States (4 Apr 1988).

Anion diffusivities in the lattice and along grain boundaries have been measured on sintered polycrystals of Cr_2O_3 and Cr_2O_3-0.09 weight percent Y_2O_3 at 1100{degree}C and at the oxygen partial pressure corresponding to that of the Cr/Cr_2O_3 equilibrium at that temperature. Results show that under the same conditions, anion diffusion is significantly faster than cation diffusion. The results are discussed in terms of their implications for the reactive element effect on high temperature oxidation of chromia forming alloys. 10 refs., 3 figs., 1 tab.

15280 (UCRL—99694) Shock compaction of superconductors. Nellis, W.J.; Landingham, R.L.; Holt, J.B.; Maple, M.B.; Seaman, C.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 4p. (CONF-881060—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006744/JAW.

From HERAPS '88: international seminar on high energy working of rapidly solidified materials; Novosibirsk, USSR (10 Oct 1988).

Shock compression has several features which indicate a high potential for the processing of practical superconductors and for the synthesis of new superconducting phases/1/. By using shock waves a dynamic pressure pulse in the range 10-1000 kbar can be applied for a duration of order 1 μsec. The pressures, densities, temperatures, strain rates, and quench rates are substantially larger than for conventional processing methods. High quench rates could be used to synthesize new metastable high-T/sub c/ phases, where T/sub c/ is the superconducting critical transition temperature. The fast nature of the process also permits the heterogeneous processing of powders. That is, by compacting powders in a μsec, compressive energy is deposited heterogeneously on particle boundaries. This dynamic method offers the opportunity to achieve high density and to selectivity process the grain boundary region in high-T/sub c/ superconductors. Since controlling the grain boundary region is essential to achieving high critical current density J/sub c//3/, shock compaction might produce the microstructure required for high J/sub c/. An example is given of shock compaction of $YBa_2Cu_3O_7$ + Ag powders. 6 refs., 2 figs.

15281 Detection of surface (~1 μm) impurity phases in high T/sub c/ superconductors. Cooke, D.W.; Jahan, M.S.; Smith, J.L.; Maez, M.A.; Hults, W.L.; Raistrick, I.D.; Peterson, D.E.; O'Rourke, J.A.; Richardson, S.A.; Doss, J.D.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **54**: No. 10, 960-962(6 Mar 1989).

We show that thermally stimulated luminescence is an important method for detecting insulating impurity phases that commonly occur in high T/sub c/ superconductors. The technique is sensitive to impurity phases at <1% level with a probe depth of ~ 1 μm, which is the region of interest for many superconductor applications. Samples of Y_2O_3, Y_2BaCuO_5, YBa_2Cu_3O/sub 6.2/, $BaCO_3$, Ba_3CuO_4, $BaCuO_2$, and YBa_2Cu_3O/sub x/ (x≅7) were investigated. All but the high quality sintered pellets of YBa_2Cu_3O/sub x/ exhibited relatively intense luminescence. The absence of luminescence, and thus of insulating phases, is correlated with low values of rf surface resistance.

15282 X-ray, neutron-, and electron diffraction study of the incommensurate structure in single cystals of Bi/sub 2.2/Sr/sub 1.9/$CaCu_2O$/sub 8+//sub x/. Fischer, J.E.; Heiney, P.A.; Davies, P.K.; Vaknin, D. (Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6272). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2752-2755(1 Feb 1989).

We have used x-ray, neutron, and electron diffraction to study the incommensurate structure in superconducting single crystals of Bi/sub 2.2/Sr/sub 1.9/CaCuO/sub 8+//sub x/ at 300 K. Large differences between relative x-ray and neutron superlattice intensities imply a large oxygen contribution to the modulation. While the positions of the superlattice peaks are symmetric in Q/sub H/ and Q/sub K/ about the sublattice (020) reflection, the intensities are not. This probably rules out a sinusoidal one-dimensional mass density wave interpretation.

15283 Ultrasonic attenuation investigation of the reentrant superconductor Er/sub 0.705/H/sub 0.295/Rh_4B_4. Sun, K.J.; Levy, M.; Maple, M.B.; Torikachvilli, M.S. (Physics Department, University of Wisconsin—Milwaukee, Milwaukee, Wisconsin 53201). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2159-2164(1 Feb 1989).

Temperature-dependent and magnetic-field-dependent ultrasonic attenuation measurements in Er/sub 0.705/Ho/sub 0.295/Rh_4B_4 reflect the unusual magnetic and superconducting properties of this sample. Experimental data agree with theoretical predictions and verify that electromagnetic interaction is the predominant interaction in that sample at low temperatures.

15284 Oxygen isotope study of $YBa_2Cu_3O_7$. Hoen, S.; Creager, W.N.; Bourne, L.C.; Crommie, M.F.; Barbee T.W. III; Cohen, M.L.; Zettl, A.; Bernardez, L.; Kinney, J. (Department of Physics, University of California at Berkeley, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2269-2278(1 Feb 1989).

The magnitude of the oxygen isotope effect in the high-T/sub c/ superconductor $YBa_2Cu_3O_7$ has been determined by substitution of /sup 18/O for /sup 16/O. A series of cross exchanges was performed on high-quality polycrystalline specimens to eliminate uncertainties due to sample heat treatments and sample inhomogeneities. Magnetic measurements suggest a relative isotope shift for the bulk material of -0.17 +- 0.03 K at 80 at. % /sup 18/O substitution, yielding α/sub bulk/ = 0.019 +- 0.004 where T/sub c/~M^{-}/sup α/ and M is the oxygen mass. Resistivity measurements in freshly prepared specimens reveal filamentary superconductivity 1 or 2 K above the bulk superconducting transition temperature. The isotope shift associated with the filamentary superconductivity is similar to but slightly larger than the bulk shift: α/sub fil/ = 0.028 +- 0.003. The filamentary superconductivity is time dependent and disappears several months after sample preparation. We show that the above values of α are inconsistent with the standard three-dimensional phonon-mediated Bardeen-Cooper-Schrieffer theory, and discuss implications for alternative possibilities.

15285 Successive antiferromagnetic phase transitions in single-crystal La_2CoO_4. Yamada, K.; Matsuda, M.; Endoh, Y.; Keimer, B.; Birgeneau, R.J.; Onodera, S.; Mizusaki, J.; Matsuura, T.; Shirane, G. (Department of Physics, Tohoku University, Aramaki Aoba, Sendai 980, Japan). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2336-2343(1 Feb 1989).

We have observed successive magnetic phase transitions in a La_2CoO_4 single crystal by neutron scattering measurements. Antiferromagnetic long-range order of the La_2NiO_4 type, tau[100], S[100], is observed with Neel temperature T/sub N/ = 275 K in the orthorhombic (Cmca) phase. As the temperature is lowered, a first-order phase transition to a new tretragonal phase is found at T_2~135 K. This structural phase transition is accompanied by a Co/sup 2+/ (S = (3/2) spin rotation or flip in the CoO_2 plane which results in a new spin structure with the spin direction S perpendicular to tau, the propagation vector of the antiferromagnetic structure. The spin direction itself of this phase cannot be determined uniquely due to the tetragonal symmetry and indeed the most likely structure is noncollinear. In contrast to the S = 1/2 Heisenberg system La_2CuO_4, well-defined two-dimensional Ising critical phenomena are observed and the two-dimensional spin correlations at T>T/sub N/ are almost entirely elastic.

15286 Ferromagnetic instability in the heavy-electron compound URu_2Si_2 doped with Re or Tc. Dalichaouch, Y.; Maple, M.B.; Torikachvili, M.S.; Giorgi, A.L. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2423-2431(1 Feb 1989).

We report the first ferromagnetic instability observed in a heavy-electron system. Solid solutions of URu/sub 2-//sub x/M/sub x/Si_2, where M = Re or Tc, have been found to undergo a ferromagnetic transition in the concentration range 0.4approx. <xapprox. <1.4. Magnetization M measurements at 5 K reveal a small saturation moment that attains maximum values of 0.44μ/sub B//U atom at x≅0.8 for Re and 0.27μ/sub B//U atom at x≅1 for Tc. The Curie temperature FTHETA/sub C/ vs x in URu/sub 2-//sub x/Re/sub x/Si_2 also exhibits a maximum at x≅0.8. The electrical resistivity of both the Re- and Tc-substituted systems contains a T^2 contribution below FTHETA/sub C/, indicative of electron-magnon scattering. The low-temperature coefficient of the electronic specific heat, γ, in the URu/sub 2-//sub x/Re/sub x/Si_2 system initially increases with x, attains a value of 160 mJ/mol K^2 at x = 0.6, and then decreases with further increase of x. X-ray diffraction analyses indicate a crystallographic transformation in the URu/sub

2-//sub x/M/sub x/Si_2 (M = Re, Tc) systems from tetragonal to cubic symmetry at x≅1.

15287 **Unoccupied electronic structure of single-crystal La_2CuO_4.** Brookes, N.B.; Viescas, A.J.; Johnson, P.D.; Remeika, J.P.; Cooper, A.S.; Smith, N.V. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973-6000). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2736-2739(1 Feb 1989).

Single crystals of lanthanum cuprate have been studied using k-resolved inverse photoemission. The predicted dispersion of the Cu 3d—O2p-derived band through the Fermi level is not observed and this may influence models for high-temperature superconductivity based on band-structure calculations. In addition, resonant inverse photoemission of the lanthanum-derived features is also observed at the plasmon frequencies.

15288 **Observation of trapped O_2 in high-T/sub c/ metal oxide superconductors.** Chen, C.H.; Phillips, R.C.; McCann, M.P. (Chemical Physics Section, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6378). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2744-2747(1 Feb 1989).

Trapped molecular oxygen was observed from Y-Ba-Cu-O and Tl-Ca-Ba-Cu-O superconductors by laser desorption mass spectroscopy. We speculate that trapped O_2 may play an important role in superconductivity for the newly discovered high-T/sub c/ metal oxide superconductors.

15289 **Muon-spin-rotation measurement of magnetic field penetration and flux pinning in superconducting $EuBa_2Cu_3O$/sub x/.** Cooke, D.W.; Hutson, R.L.; Kwok, R.S.; Maez, M.; Rempp, H.; Schillaci, M.E.; Smith, J.L.; Willis, J.O.; Lichti, R.L.; Chan, K.C.B.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2748-2751(1 Feb 1989).

Muon-spin-rotation measurements have been used to determine the magnetic field penetration depth λ as a function of temperature T in superconducting, sintered $EuBa_2Cu_3O$/sub x/(x≅7). The extrapolated value at 0 K, λ(0), is 1700 A. The temperature dependence of λ(T) in the interval 3.5 K to T/sub c/ is well described by the phenomenological relation λ(T) = λ(0)[1-(T/T/sub c/)^4]/sup -1/2/. For T<T/sub c/, approximately 85% of the muons stop within the superconducting grains, whereas ≅15% reside in normal regions, perhaps at grain boundaries. At T = 3.5 K the field-cooled superconductor has expelled only 2.3% of the applied magnetic field, indicating strong flux pinning in the material.

15290 **Static and dynamic spin fluctuations in superconducting La/sub 2-//sub x/Sr/sub x/CuO_4.** Birgeneau, R.J.; Endoh, Y.; Hidaka, Y.; Kakurai, K.; Kastner, M.A.; Murakami, T.; Shirane, G.; Thurston, T.R.; Yamada, K. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2868-2871(1 Feb 1989).

We report a neutron scattering study of the spin fluctuations in samples of La/sub 1.89/Sr/sub 0.11/CuO_4 which are ~80% superconducting with T/sub c/ = 10 K. The structure factor, S(Q), reflects three dimensional modulated spin correlations with an in-plane correlation length of order 18 +- 6 A. The fluctuations evolve with temperature from being predominantly dynamic at high temperatures to mainly quasielastic (chemical bondΔEchemical bond<0.5 meV) at low temperatures. No significant differences are observed in the normal and superconducting states.

15291 **Flux expulsion and penetration in superconducting YBa_2Cu_3O/sub 7-//sub δ/.** Foldeaki, M.; McHenry, M.E.; O'Handley, R.C. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2883-2886(1 Feb 1989).

A large difference in the rate of flux flow in $YBa_2Cu_3O_7$/sub -//sub δ/ superconductors is observed between flux expulsion (field cooling then removing the field) and flux penetration (zero-field cooling then switching on a field). The mean activation energy and the width of its distribution for flux expulsion are 14 and 28 meV and for flux penetration are 34 and 67 meV. The smaller activation barrier for flux expulsion relative to flux penetration can be explained quantitatively in terms of flux pinning at the surface image potential and is also consistent with a model of randomly coupled superconducting grains.

15292 **Resonant inverse photoemission of Bi_2Ca/sub 1+//sub x/Sr/sub 2-//sub x/Cu_2O/sub 8+//sub y/ and YBa_2Cu_3O/sub 7-//sub x/, unoccupied oxygen states, and plasmons.** Wagener, T.J.; Hu, Y.; Gao, Y.; Jost, M.B.; Weaver, J.H.; Spencer, N.D.; Goretta, K.C. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2928-2931(1 Feb 1989).

Inverse photoemission studies of the unoccupied states of Bi_2Ca/sub 1+//sub x/Sr/sub 2-//sub x/Cu_2O/sub 8+//sub y/ and YBa_2Cu_3O/sub 7-//sub x/, with and without 10% Pb substitution for Bi, show a low density of states within 2 eV of the Fermi level and broad structures at 4, 9.6, and 12.6 eV that are associated with Bi 6p, Ca 3d, and Sr 4d empty state bands. Plasmon losses are observed via their radiative decay at photon energies of 15 and 21.2 eV. Resonant inverse photoemission, using incident electron energies that excite O 2s shallow core levels, enhances emission from the unoccupied O 2p levels. Resonance results for YBa_2Cu_3O/sub 7-//sub x/ and Bi_2Ca/sub 1+//sub x/Sr/sub 2-//sub x/Cu_2RO/sub 8+//sub y/ show similar oxygen distributions near E/sub F/.

15293 **Synthesis and properties of nonstoichiometric samples of YBa_2Cu_3O/sub 7-//sub x/; 0.04≦x≦1.00.** Jacobson, A.J.; Newsam, J.M.; Johnston, D.C.; Goshorn, D.P.; Lewandowski, J.T.; Alvarez, M.S. (Exxon Research and Engineering Company, Route 22 East, Annandale, New Jersey 08801). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 254-258(1 Jan 1989).

A simple and accurately reproducible route was previously described for the synthesis of YBa_2Cu_3O/sub 7-//sub x/ with intermediate compositions, 0.0<x<1.0, that involves equilibration of appropriate proportions of compounds with x = 0.0 and x = 1.0 in sealed tubes. This synthetic procedure has been further explored and products studied by powder diffraction, thermogravimetric analysis, and magnetization measurements. The temperature required for such equilibrations has been studied at three representative compositions, by using sealed ssH tubes to physically separate the two components. For 0.0<x<0.4, in contrast to earlier suggestions of phase separation, powder x-ray diffraction and the superconducting properties indicate that single-phase orthorhombic materials (on a length scale greater than about 60 A) are obtained on quenching from temperatures above 350 °C. In particular, the superconducting transition temperature varies in a smooth, ssS-shaped fashion over the 0.04<x<0.40 composition field, the observed variation of the transition width with x is as expected from the variation of dT/sub c//dx in this range, and there are no indications of multiple superconducting transitions in the dc magnetization data.

15294 **Free energy of thallium-based superconductors.** Fang, M.M.; Ostenson, J.E.; Finnemore, D.K.; Farrell, D.E.; Bansal, N.P. (Ames Laboratory: United States Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 222-224(1 Jan 1989).

Free energy surfaces have been determined for both $Tl_2Ba_2Ca_1Cu_2O_8$ and $Tl_2Ba_2Ca_2Cu_3O$/sub 10/ in order to determine the thermodynamic aspects of vortex formation in the mixed state of these materials. For fields up to 5 T the free energy change, G(H)-G(0) is found to be linear in temperature, over a wide temperature range, thus indicating that the specific heat is roughly independent of magnetic field. The slope of the upper critical field versus temperature plot is at least 20 T/K. These two materials obey a law of corresponding states.

15295 Pairing interaction in CuO clusters. Hirsch, J.E.; Loh Jr., E.; Scalapino, D.J.; Tang, S. (Department of Physics, University of California, San Diego, La Jolla, California 92093). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 243-253(1 Jan 1989).

We examine the tendency to pairing of holes added on CuO clusters with one hole per Cu as the reference state, for a variety of cluster geometries. The model Hamiltonian considered contains on-site and short-range Coulomb repulsion terms. Confirming and extending our previous results, we find a tendency to pairing for a wide range of parameters in the model Hamiltonian. The tendency to pairing arises from a disruption of the local order in the insulating system (with one hole per Cu) by addition of the extra holes. We discuss to what extent it is possible to identify the pairing mechanism as "charge mediated" or "spin mediated" as a function of the parameters. We examine the stability of the system with respect to real condensation (phase separation) in the regime where the pair interaction is attractive. Finally, we discuss the possible connection of our results to the superconductivity mechanism in high-T/sub c/ oxides.

15296 NMR measurement of the exchange coupling between Cu(2) atoms in YBa_2Cu_3O/sub 7-//sub δ/ (T/sub c/ = 90 K). Pennington, C.H.; Durand, D.J.; Slichter, C.P.; Rice, J.P.; Bukowski, E.D.; Ginsberg, D.M. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 274-277(1 Jan 1989).

The authors report the transverse NMR relaxation of chain [Cu(1)] and plane [Cu(2)] nuclei in a single crystal of YBa_2Cu_3O/sub 7-//sub δ/(T/sub c/ = 90 K) in the normal state. They demonstrate the existence of a strong indirect spin-spin coupling between CU(2) nuclei, and show that it can be explained using a model in which the Cu(2) atoms possess electronic magnetic moments which are exchange coupled to one another. In such a model, the strength of the coupling implies an effective electronic exchange coupling J/sub eff/≅1100 cm/sup -1/.

15297 Anistropic Cu Knight shift and magnetic susceptibility in the normal state of $YBa_2Cu_3O_7$. Takigawa, M.; Hammel, P.C.; Heffner, R.H.; Fisk, Z.; Smith, J.L.; Schwarz, R.B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 300-303(1 Jan 1989).

Precise measurements of the Knight shift at Cu(1) (chain) and Cu(2) (plane) sites have been made in the normal state of a $YBa_2Cu_3O_7$ powder sample, for which the c axis of each grain has been aligned in a magnetic field. By combining these data with the Knight shift data in the superconducting state and the anisotropic magnetic susceptibility, it is shown that: (1) the anisotropy of the magnetic susceptibility is mainly due to the orbital moment of the 3d electrons, (2) the magnitude of the spin contribution to the Knight shift is similar at both sites, and (3) the isotropic part of the Cu hyperfine field is large and positive (112 kOe/μ/sub B/).

15298 Magnetic and structural properties of YBa_2Cu_3O/sub 7-//sub x/F/sub y/ as prepared by a NF_3 gas anneal. LaGraff, J.R.; Behrman, E.C.; Taylor, J.A.T.; Rotella, F.J.; Jorgensen, J.D.; Wang, L.Q.; Mattocks, P.G. (Institute for Ceramic Physics, New York State College of Ceramics, Alfred University, Alfred, New York 14802). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 347-355(1 Jan 1989).

YBa_2Cu_3O/sub 7-//sub x/F/sub y/, y = 0.08 to 1.11, has been prepared by annealing YBa_2Cu_3O/sub 7-//sub x/ (1:2:3) in NF_3 gas. X-ray and neutron-diffraction studies show that the fluorine is structurally incorporated into the CuO chains, in the normally vacant O(5) sites along the a axis. Structurally this results in a decrease in the orthorhombic strain (b-a)/(b+a). This material exhibits significant increases in diamagnetic expulsion and exclusion as a function of fluorine content, but no increase in T/sub c/. At sufficiently long anneal times (large y) the material undergoes an orthorhombic-to-tetragonal phase transition, and no longer superconducts. An amorphous phase also appears. These results tie together the various conflicting reports of fluorination of 1:2:3.

15299 Monte Carlo study of the two-dimensional spin-1/2 quantum Heisenberg model: Spin correlations in La_2CuO_4. Manousakis, E.; Salvador, R. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 575-585(1 Jan 1989).

We study the spin-1/2 quantum ferromagnetic and antiferromagnetic Heisenberg model using Handscomb's Monte Carlo (MC) method on square lattices of various sizes. As the temperature is lowered the calculated correlation length in the antiferromagnetic case grows more rapidly than in the ferromagnetic case. We also obtain the correlation length in the leading order of the high-temperature series expansion which, at high temperatures, agrees very well with the MC results. The correlation length obtained from the MC calculation for the ferromagnetic and antiferromagnetic case is compared with existing theories. Taking the average value for the antiferromagnetic coupling between the values suggested by neutron- and Raman-scattering experiments done on La_2CuO_4, we compare our results for the correlation length with those observed by the neutron-scattering experiments. We find that our results for the correlation lengths away from the three-dimensional (3D) Neel temperature T/sub N/∼200 K are consistent with the experimental findings. In order to obtain agreement close to the Neel temperature, however, we need to introduce an interlayer coupling between the CuO_2 planes. The effect on a 3D coupling is only discussed in the framework of the quantum mechanical nonlinear σ model in three space dimensions. For the case of La_2CuO_4 we find that close to T/sub N/ the σ model in 3+1 dimensions reduces to the classical 3D Heisenberg model whose critical properties are known and fit the neutron-scattering data for T∼T/sub N/.

15300 De Haas—van Alphen effect in the Anderson lattice for large orbital degeneracy. Rasul, J.W. (Department of Physics, Temple University, Barton Hall, Philadelphia,). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 663-670(1 Jan 1989).

The de Haas—van Alphen (dHvA) effect is investigated theoretically starting from the Anderson lattice model generalized to finite spin-orbit degeneracy N. In the large-N limit a large mass enhancement is found in the dHvA amplitude but not in the oscillatory term (dependent on the Fermi-surface area). Extending the calculation of the free energy to next order in the 1/N expansion and to leading order in the oscillations, we show that the mass enhancement occurring in the dHvA amplitude is the same as that found in the specific heat. This result is in agreement with recent experiments on CeB_6.

15301 Charge-density waves and superconductivity in the Ba/sub 1-//sub x/K/sub x/BiO/sub 3-//sub y/ system. Pei, S.; Zaluzec, N.J.; Jorgensen, J.D.; Dabrowski, B.; Hinks, D.G.; Mitchell, A.W.; Richards, D.R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 811-814(1 Jan 1989).

Electron diffraction confirms the existence of a cubic phase and a phase having a √2 a x √2 a x 2a supercell in the Ba/sub 1-//sub x/K/sub x/BiO_3 system. It is also found that the supercell phase displays an additional incommensurate structural modulation along the [110] cubic direction. Since the modulation is observed in the semiconducting supercell phase and not in the superconducting cubic phase, such an observation leads to spectulation that superconductivity in the Ba/sub 1-//sub x/K/sub x/BiO_3 system is associated with the disappearance of a charge-density wave.

15302 Antiferromagnetism of CuO_2 layers. Weinert, M.; Fernando, G.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 835-838(1 Jan 1989).

Based on symmetry arguments and supported by electronic structure calculations, we show that an important possible antiferromagnetic state of CuO_2 planes has the moments on the O, rather than the Cu, sites. This and other proposed "broken-symmetry" orderings are a direct result of correlation effects and argue for holes on oxygen. In addition, calculations of the core-level shift between

La_2CuO_4 and the extreme doping limit of CuO_2 show that the Cu charge state remains unchanged. These results should have important implications for the symmetry of models of the high-T/sub c/ copper oxide superconductors.

15303 **Observation of the full time evolution of the nuclear collective-decay mode in crystalline /sup 57/Fe_2O_3 excited by synchrotron radiation.** Faigel, G.; Siddons, D.P.; Hastings, J.B.; Haustein, P.E.; Grover, J.R.; Berman, L.E. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **61**: No. 24, 2794-2796(12 Dec 1988).

The full time evolution of the coherent deexcitation of the 14.4-keV nuclear resonance, excited by synchrotron radiation in a single crystal of the simple antiferromagnet /sup 57/Fe_2O_3 has been measured. The buildup from zero decay probability at time zero following excitation, increasing to a maximum 2.4 nsec later, has been observed experimentally for the first time. The results are in good agreement with calculations based on the dynamical theory of nuclear Bragg scattering.

15304 **Some optical properties of KTP, LiIO/sub 3/, and LiNbO/sub 3/.** Gettemy, D.J.; Harker, W.C.; Lindholm, G. (Los Alamos National Lab., Los Alamos, NM 87545 (US)); Barnes, N.P. (NASA Langley Research Center, Hampton, VA 23665 (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 11, 2231-2237(Nov 1988).

Measurements of the absorption coefficient for KTP, LiIO/ sub 3/, and LiNbO/sub 3/ have been made. Variation of the refractive index with temperature has been measured for KTP and LiIO/ sub 3/. It is necessary to know both the absorption coefficient β and the variation in the indexes of refraction with temperature change dn/dT to determine the average power limit of a nonlinear interaction. With the dn/dT information, it is also possible to estimate the temperature half width of any nonlinear interaction by calculating the variation of the phase matching condition with temperature.

15305 **LiCaAl/sub 6/:Cr/sup 3+/.** Payne, S.A.; Chase, L.L.; Newkirk, H.W.; Smith, L.K.; Krupke, W.F. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 11, 2243-2252(Nov 1988).

The authors report the discovery of a new laser, LiCaAlF/ sub 6/:Cr/sup 3/ (Cr/sup 3+/ :LiCAF). The intrinsic (extrapolated maximum) slope efficiency was found to be 67 percent. For comparison, they also measured the intrinsic slope efficiencies of BeAl/ sub 2/O/sub 4/:Cr/sup 3+/ (alexandrite), Na/sub 3/Ga/sub 2/Li/ sub 3/F/sub 12/:Cr/sup 3+/, and ScBO/sub 3/:Cr/sup 3+/, and obtained values of 65,28, and 26 percent, respectively. The tuning range of LiCaAlF/sub 6/:Cr/sup 3+/ was determined to be at least 720-840 nm. The conventional spectroscopic properties, such as the absorption, emission, and emission lifetimes as a function of temperature, are reported as well.

15306 **Theory and experiments of fracture in cyclic compression.** Suresh, S.; Brockenbrough, J.R. (Div., of Engineering, Brown Univ., Providence, RI (US)). *Acta Metallurgica;* **36**: No. 6, 1455-1470(Jun 1988).

The application of cyclic compressive stresses to notched plates of brittle solids can lead to stable crack growth along the plane of the notch in a direction normal to the far-field compression axis. This paper presents experimental results and constitutive models for single phase ceramics, transforming ceramics and ceramic composites with the aim of developing the framework for a general theory of cyclic compression fracture in notched brittle solids. Firstly, the results of a recent constitutive model for microcracking brittle solids in cyclic compression are briefly summarized. Next, a generalized constitutve formulation for martensitic transformations which considers both volumetric and shear strains is developed. A finite element analysis gives the near-tip residual stress field, where numerical results for microcracking single phase ceramics and transformation-toughened ceramics illustrate the inducement of notch-tip residual tensile stresses upon unloading from a far-field compressive stress. Large residual tensile stresses are created over a distance which is greater than the characteristic microstructural dimension, but comparable to the experimentally-observed distance of crack growth after one compression cycle. The results obtained for ceramics are compared with previous studies of notch-tip residual tensile fields for metallic materials.

15307 **Laser synthesized ceramic powders - Synthesis, characteristics, fabrication, and part properties.** Flint, J.H.; Haggerty, J.S. pp 539-546 of Symposium on High Temperature Materials Chemistry - IV, Honolulu, HI, Oct. 19-23, 1987, Proceedings. Munir, Z.A.; Cubicciotti, D.; Tagawa, H. Pennington, NJ; Electrochemical Society, Inc. (1988). (CONF-8710216—).

From 4. symposium on high-temperature materials chemistry; Honolulu, HI, USA (18 Oct 1987).

Si, Si_3N_4, SiC, TiB_2, TiO_2, and B powders have been made from laser-heated gaseous reactants. The unusual and precisely controllable reaction conditions made possible with this heating technique permit uniform, small, high-purity, nonagglomerated powders to be made at high rates. The synthesis process has been modeled empirically and analytically to give direct measures of particle diameters, number densities, and temperatures as well as velocities, mixing, and stability limits. With careful postsynthesis processing, these powders can be made into defect-free parts with rapid, low-temperature consolidation schedules. Resulting reaction bonded silicon nitride and sintered silicon carbide parts exhibit much improved properties. 25 references.

15308 **Selection and use of wear tests for ceramics; Proceedings of the Symposium on Selection and Use of Wear Test Systems for Ceramics, Cincinnati, OH, May 13, 1987.** Yust, C.S.; Bayer, R.G. Philadelphia, PA; American Society for Testing and Materials (1988). 102p. (CONF-8705359—).

From Selection and use of wear tests for ceramics; Cincinnati, OH, USA (13 May 1987).

The papers presented in this volume focus on the wear testing of ceramics for a variety of applications. Topics discussed include the development of a wear test methodology, pin-on-disk wear tests for evaluating ceramic cutting tool materials, and systematic testing of ceramic rolling bearing elements. The discussion also covers friction and wear testing of ion beam modified ceramics for high temperature low heat rejection diesel engines.

15309 **Search for new high-temperature superconducting copper oxides.** Dabrowski, B.; Hinks, D.G. (Argonne National Lab., Building 223, 9700 S. Cass Av., Argonne, IL (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

Resistivity measurements are a sensitive method for the detection of a superconductive phase in a multiple-phase sample. Using this technique, the authors have studied around 200 copper M/sub 1/M/sub 2/ oxide compositions with M = Th/sup +4/, Y/ sup +3/, La/sup +3/, Nd/sup +3/, Bi/sup +3/, Ba/sup +2/, Sr/sup +2/, Ca/sup +2/, Cd/sup +2/, K/sup +1/, or Na/sup +1/. We did not find evidence for any new superconducting phases other then the known REBa/sub 2/Cu/sub 3/O/sub 7/ and La/sub 2-x/M/sup +2//sub x/CuO/sub 4/, despite the presence of many good metallic compounds. We have found that neither the substitution of fluorine or sulfur in REBa/sub 2/Cu/sub 3/O/sub 7/, nor temperature cycling near 240K enhance Tc's. However, they have found nonreproducible resistive anomalies at about 240K which may be due to the freezing of water vapor. Also, by carefully preparing the REBa/sub 2/Cu/sub 3/O/sub 7/ series, they find the systematic change of T/sub c/ to be proportional to the size of RE atom.

15310 **Ceramic processing of high-T/sub c/ superconductors.** Poeppel, R.B.; Singh, J.P.; Lanagan, M.T.; Goretta, K.C.; Dusek, J.T.; Capone, D.W. II (Materials and Components Technology Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US));. pp v of Sensing, discrimination, and signal processing superconducting materials and instrumentation. Nichols, R.; Ionson, J.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1988). (CONF-880198—).

From Sensing, discrimination, and signal processing and superconducting materials and instrumentation; Los Angeles, CA, USA (12 Jan 1988).

The means by which superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/ powders can be synthesized are summarized. Methods of forming powders into useful shapes are then described. Lastly, heat treatment schedules used for consolidation of the powders into dense, sound bodies with good superconducting properties are discussed.

15311 **Crystal lattice measurements in superconducting materials.** Lytle, F.W.; Marques, E.C.; Greegor, R.B.; Ahlstrom, H.G. (The Boeing Co., Seattle, WA (US)); Larson, E.M.; Peterson, D.E. (Los Alamos National Lab., Los Alamos, NM (US)); Panson, A.J. (Westinghouse Research and Development Center, Pittsburgh, PA (US));. pp v of Sensing, discrimination, and signal processing superconducting materials and instrumentation. Nichols, R.; Ionson, J.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1988). (CONF-880198—).

From Sensing, discrimination, and signal processing and superconducting materials and instrumentation; Los Angeles, CA, USA (12 Jan 1988).

The EXAFS technique was used to investigate the structural parameters of the Y and Cu atoms in Yba/sub 2/Cu/sub 3/O/sub 7/. An antisite disorder of 0.16+-0.05 mole fraction was found between the Y and Cu/sub 2/ sites. It was also demonstrated that powder x-ray and neutron diffraction techniques are insensitive to this degree of disorder.

15312 **Superconductivity in copper oxide compounds - prospects and perspectives.** Maple, M.B. (Dept. of Physics and Institute for Pure and Applied Physical Sciences Univ. of California, San Diego, La Jolla, CA (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

In this paper the author reviews some of the remarkable developments that have taken place in the field of high temperature superconducting materials during the last year and a half or so. The materials he reviews include the systems La/sub 2-x/M/sub x/CuO/sub 4-δ/, where M is one of the alkaline earths Ca, Sr, and Ba, as well as the alkali metal Na, and δ is the oxygen defect concentration. In this system, superconductivity has been observed at temperatures up to —40 K for M = Sr[1-3] and, more recently, M = Na [4,5]. Superconductivity ar—30 K in the system La/sub 2-x/Ba/sub x/CuO/sub 4-δ/ was discovered by others, which is how this whole new field of very high temperature superconductivity in oxides got started. Another important class of materials are the RBa/sub 2/Cu/sub 3/O/sub 7-δ/ compounds which are all superconducting near 95 K for R = Y or a lanthanide element except for Ce, Pr, and Tb. The discovery of superconductivity in YBa/sub 2/Cu/sub 3/O/sub 7-δ/ at temperatures well above the boiling temperature of liquid nitrogen (77 K) by others was a major development which gave great impetus to this new field. Several superconducting phases have been found in the Bi-Sr-Ca-Cu-O system, one of which shows indications of superconductivity at temperatures as high as —110 K, according to others. He also discusses the antiferromagnetic order that occurs in some of these compounds, involving both the Cu/sup 2/ ions at relatively high temperatures near or above room temperature and the R/sup 3+/ ions at low temperatures in the neighborhood of 1 K. The interrelationship between superconductivity and the Cu/sup 2+/ magnetism is especially interesting in view of the possibility that a magnetic pairing mechanism is responsible for the high temperature superconductivity in these materials.

15313 **Phase equilibria studies near the superconducting YBa/sub 2/Cu/sub 3/O/sub x/ composition by a solid-state ionic technique.** Ahn, B.T.; Gur, T.M.; Huggins, R.A.; Beyers, R.; Engler, E.M. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

This paper reports the findings of a phase-equilibrium study of the Y-Ba-Cu-O quaternary system in which the oxygen activity was monitored and controlled by a solid-state ionic technique. A stabilized zirconia electrolyte was used to titrate oxygen in or out of the sample and to monitor the oxygen activity inside a sealed sample chamber. Compositions at or near YBa/sub 2/Cu/sub 3/O/sub x/ were studied at elevated temperatures in a wide range of oxygen pressures. All compositions indicated the presence of an invariant polyphase reaction-- e.g., at 1 x 10/sup -3/ atm of oxygen pressure at 850°C-- below which the superconducting phase becomes thermodynamically unstable and undergoes a decomposition reaction. Complementary x-ray diffraction analysis of samples prepared under well-defined oxygen pressures identified the phases present and, along with the oxygen coulometric titration data, allowed the construction of a portion of the relevant quarternary phase diagram.

15314 **The n-p transition in YBa/sub 2/Cu/sub 3/O/sub 6 . 5 + x/.** Choi, G.M.; Tuller, H.L.; Tsai, M.J. (Crystal Physics and Optical Electronics Lab., Dept. of Materials Science and Engineering, Massachusetts, Institute of Technology, Cambridge, MA (US)). pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The role of annealing conditions on the equilibrium defect state of the material was investigated by computer controlled 4 probe d.c. conductivity and thermoelectric power measurements on dense homogeneous ceramics prepared from citrate precursors. At elevated temperatures, the conductivity first decreases and then increases exponentially with decreasing temperature with the conductivity minima shifting to lower temperatures with decreasing PO/sub 2/. This unusual behavior is described as representing a transition from n-type to p-type conduction. The n-p transition is correlated with the corresponding stoichiometry shift upon cooling from oxygen deficient (Cu/sup 1+/, Cu/sup 2+/) to oxygen excess YBa/sub 2/Cu/sub 3/O/sub 6 . 5 + x/ (Cu/sup 2+/, Cu/sup 3+/). A preliminary defect model is proposed which provides a framework for understanding a number of the experimental observations.

15315 **Processing relationships in YBa/sub 2/Cu/sub 3/O/sub 7-x/ superconductors.** Weber, W.J.; Pederson, L.R.; Maupin, G.D.; Le Blanc, E.J. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Samples of YBa/sub 2/Cu/sub 3/O/sub 7-x/ were prepared by solid state reaction of Y/sub 2/O/sub 3/, BaO/sub 2/, and CuO powders mixed in stoichiometric proportions. Powders reacted at 900°C-925°C in air were pressed at 35 MPa into rectangular bars and sintered at 950°C in air for six hours. Slow cooling at 50°C/hour promoted complete transformation to the orthorhombic structure. The effects of subsequent oxidation processing on superconducting properties were also investigated. Oxidation anneals at one atmosphere pressure in flowing O/sub 2/ over the temperature range from 300 to 550°C were performed. Results indicate that oxidation at 450°C optimized the superconducting transition temperature at 91K with a 2-degree transition width. Subsequent high-pres-

sure oxidation (2000 psi O/sub 2/) at 200°C for one week significantly degraded the superconducting characteristics. Results based on iodometric titration, thermogravimetric analysis, and x-ray photoelectron spectroscopy suggest that the copper valency is about 2.3 and oxygen stoichiometry is 6.94 (x - 0.06) in samples processed to optimize superconducting properties.

15316 **A hydroxycarbonate route to superconductor precursor powders.** Voight, J.A.; Bunker, B.C.; Doughty, D.H.; Lamppa, D.L.; Kimball, K.M. (Sandia National Labs., Albuquerque, NM (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

A precipitation process is described for the preparation of powders that can be thermally decomposed to form high critical temperature superconductors such as YBa/sub 2/Cu/sub 3/O/sub 7/. In the process, a cationic solution (a concentrated chloride or nitrate solution) is instantaneously mixed with an anionic solution (a mixture of tetramethylammonium hydroxide and carbonate) to produce a metal-hydroxycarbonate precipitate having the metal stoichiometry of the desired superconducting oxide. The calcining and sintering of the precipitates is critical in controlling the structural integrity and morphology of the superconducting ceramics made from the chemical prep powder, as well as controlling superconducting properties. Under appropriate conditions, high density (>95%) materials that exhibit good superconducting characteristics can be prepared with the chem-prep powders.

15317 **Electronic structure and antiferromagnetism in La/sub 2/CuO/sub 4/.** Sterne, P.A.; Wang, C.S.; Stocks, G.M.; Temmerman, W.M. (Oak Ridge Nat. Lab., Oak Ridge, TN (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Self-consistent spin-polarized energy bands have been calculated for tetragonal and orthorhombic La/sub 2/CuO/sub 4/. No stable antiferromagnetic order is found in either the stoichiometric compound or oxygen deficient La/sub 2/CuO/sub 3.75/. Constraining the occupancy of Brillouin zone boundary states leads to a small antiferromagnetic moment in both systems which is rapidly quenched by Ba doping.

15318 **Deposition of high T/sub c/ superconductor thin films by pulsed laser ablation.** Mashburn, D.N.; Geohegan, D.B.; Eres, D.; Lowndes, D.H.; Boatner, L.A.; Sales, B.C.; Pennycook, S.J.; Culbertson, R.J.; Sonder, E.; Christen, D.K. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Thin superconducting films of YBa/sub 2/Cu/sub 3/O/sub 7/ and HoBa/sub 2/Cu/sub 3/O/sub 7/ have been obtained by ablating material from high-T/sub c/ bulk superconductor ceramics onto a nearby substrate using focused excimer laser radiation. Subsequent annealing in oxygen at elevated temperatures was necessary to achieve the superconducting phase. A range of deposition and annealing conditions was investigated to yield films of the desired stoichiometry and phase.

15319 **Preparation of thin film YBa/sub 2/Cu/sub 3/O/sub 6+x/ ceramic superconductors by the sol-gel process.** Kramer, S.; Wu, K.; Kordas, G. (Dept. of Materials Science and Engineering, Ceramics Div. and Materials Research Lab., Univ. of Illinois at Urbana-Champaign. IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

High T/sub c/ superconducting powders and films on silicon have been fabricated by the sol-gel process. Both powder and film preparation involved the synthesis of metal alkoxides, followed by the complexation of yttrium, barium, and copper alkoxides in a common solvent. Bulk gels were then vacuum dried and fired at 700 and 950°C in flowing oxygen. Thin films on (100) silicon were fired at 700°C in flowing oxygen. Susceptibility vs temperature measurements showed that the thin films on silicon had a T/sub c/ of 40 K while the bulk gells fired under the same conditions had a T/sub c/ of 75 K. The sample fired at 950°C was superconducting at 90 K.

15320 **Freestanding films of YBa/sub 2/Cu/sub 3/O/sub 6.9/.** Ginley, D.S.; Mitchell, M.A.; Fu, W.; Kwak, J.F.; Venturini, E.L.; Baughman, R.J. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Thick (20-300 μm) freestanding films of ceramic YBa/sub 2/Cu/sub 3/O/sub 6.9/ have been obtained by resintering YBa/sub 2/Cu/sub 3/O/sub 6.9/ powder in air after screen printing onto fused silica substrates. An interfacial reaction occurs between the powder and the silica substrate which efficiently debonds the resintered film upon cooling. The magnetization and transport properties of these films are comparable to those for high quality bulk ceramic samples.

15321 **Defect structures in YBa/sub 2/Cu/sub 3/O/sub 7-x/ produced by electron irradiation.** Kirk, M.A.; Baker, M.C.; Liu, J.Z.; Lam, D.J.; Weber, H.W. (Argonne Nat. Lab., Argonne, IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Defect structures in YBa/sub 2/Cu/sub 3/O/sub 7-x/ produced by electron irradiation at 300 K were investigated by transmission electron microscopy. Threshold energies for the production of visible defects were determined to be 152 keV and 131 keV (+- 7 keV) in directions near the a and b (b>a) axes (both perpendicular to c, the long axis in the orthorhombic structure), respectively. During above threshold irradiations in an electron flux of 3x10/sup 18/ cm/sup -2/ s/sup -1/, extended defects were observed to form and grow to sizes of 10-50 nm over 1000 s in material thickness 20-200 nm. Such low electron threshold energies suggest oxygen atom displacements with recoil energies near 20 eV. The observation of movement of twin boundaries during irradiation just above threshold suggests movement of the basal plane oxygen atoms by direct displacement or defect migration processes. Crystals irradiated above threshold were observed after about 24 hours to have transformed to a structure heavily faulted on planes perpendicular to the c axis.

15322 **X-ray absorption study of Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7/ and Gd/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7/ superconductors.** Boyce, J.B.; Bridges, F.; Claeson, T.; Howland, R.S.; Geballe, T.H. (Xerox Palo Alto Research Center, Palo Alto, CA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

X-ray absorption measurements of the high-T/sub c/ superconductors Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-δ/ and Gd/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-δ/ are essentially identical and show no significant difference in either near-edge or local structure from 4.2K to 688K. The position of the Cu edge suggests that the Cu valence in the superconductors is between that in CuO (formal valence of II) and that in KCuO/sub 2/ (formal valence of III). The authors' EXAFS structural results agree well with the diffraction data. From the atomic vibrations, the authors find that the 2D Cu-

O planes and the 1D Cu-O chains form the most rigid parts of the structure, with an Einstein temperature of about 560K, compared with 390K for the Y-O bonds, 320K for Ba-O, and 260K for Cu-Cu and Y-Cu.

15323 **Effect of water and iron on slowly and rapidly cooled Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 6+x/ superconductors.** Brahme, U.S.; Kordas, G.; Kirkpatrick, R.J. (Dept. of Materials Science and Engineering, Ceramics Div., Materials Research Lab., and Dept. of Geology, Univ. of Illinois at Urbana-Champaign, IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The authors present here a study of the effect of Fe doping and hydration on the NMR, EPR spectra and T/sub c/ of slowly and rapidly cooled Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 6+x/ Superconductor. The g-values of the EPR signals are related to Cu/sup 2+/ ions in six-fold coordination. T/sub c/ is suppressed 10-20°C due to changes in processing conditions and the addition of Fe. The /sup 89/Y MAS-NMR spectra show that Y is more shielded (more ionically bonded) in the slowly cooled sample than in the rapidly cooled sample and the hydrated slowly cooled sample is less shielded. The effect of hydration on /sup 89/Y chemical shift is consistent with the presence of protons near the Y.

15324 **Vacancy ordering in the basal plane of YBa/sub 2/Cu/sub 3/O/sub z/.** Wille, L.T.; Berera, A.; DeFontaine, D.; Moss, S.C. (Lawrence Berkeley Lab., Berkeley, CA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The ordering in the Cu-O basal plane of the high T/sub c/ superconductor YBa/sub 2/Cu/sub 3/O/sub z/ is investigated. Asymmetric pairwise interactions between nearest and next nearest neighbors are assumed. Ordering instabilities in two-dimensional κ-space are mapped out as a function of the interactions and the ordered ground state superstructures consisting of occupied and empty oxygen sites are determined. A temperature-composition phase diagram is calculated by means of the Cluster Variation Method. The thermodynamic behavior of the superconducting compound is discussed in the light of these results.

15325 **Ionic models for YBa/sub 2/Cu/sub 3/O/sub 7/.** Wright, N.F.; Painter, G.S.; Busing, W.R.; Butler, W.H. (Oak Ridge Lab., Oak Ridge, TN (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Simple ionic models are applied to YBa/sub 2/Cu/sub 3/O/sub 7/. It is found that additional forces are needed to constrain the barium and the planar coordinated copper atoms to be stable in their observed positions. These additional forces are compared to forces calculated from first principles. It is observed that the restoring forces are small for motion of the "in chain" oxygen atoms perpendicular to the chains.

15326 **High-resolution x-ray microstructural study of single crystals of YBa/sub 2/Cu/sub 3/O/sub 7/-y.** You, H.; Axe, J.D.; Kan, X.B.; Moss, S.C.; Liu, J.Z.; Lam, D.J. (Brookhaven Nat. Lab., Upton, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitzawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Single crystals of YBa/sub 2/Cu/sub 3/O/sub 7-y/ were studied by transmission Laue photography and monochromatic diffraction techniques, using the Cornell High Energy Synchrotron Source and a rotating anode x-ray source. A new type of twinning, with two orthorhombic domains rotated exactly 90 degrees about the c axis, was observed in one sample and the conventional (110) type twinning in another sample with nominally identical growth conditions. A high resolution diffraction study of the sample with the conventional (110) twinning shows that measured orthorhombicity (proportional to oxygen ordering parameter) varies from one domain to another.

15327 **Neutron diffraction studies of high T/sub c/ superconductors.** Hinks, D.G.; Dabrowski, B.; Zhang, K.; Segre, C.U.; Jorgensen, J.D.; Soderholm, L.; Beno, M.A. (Argonne National Lab., Argonne, IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitzawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The authors investigated the structure and composition of La/sub 2/CuO/sub 4/ (both pure and Sr-doped) and Nd(Ba/sub 2-x/Nd/sub x/)Cu/sub 3/O/sub 7/ using powder neutron diffraction. In La/sub 2-x/Sr/sub x/CuO/sub 4/, T/sub c/ reaches its maximum at x=0.15, after which vacancies are introduced in the 2D planes and superconductivity is destroyed. Superconductivity in La/sub 2/CuO/sub 4/ is not bulk. No evidence for nonstoichiometry in this material can be observed. In the Nd(Ba/sub 2-x/Nd/sub x/)Cu/sub 3/O/sub 7/ system, T/sub c/ is a complex function of oxygen ordering and electronic effects.

15328 **The role of H in superconducting H/sub x/YBa/sub 2/Cu/sub 3/O/sub 7/.** Yang, C.Y.; Heald, S.M.; Reilly, J.J.; Suenaga, M. (Brookhaven Lab., Upton, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The authors have examined the role of H on the superconductivity properties, the atomic structure, and the electronic state in the H/sub x/YBa/sub 2/Cu/sub 3/O/sub 7/. The hydrogen solid solution phase (up to $x \cong 0.2$) exhibits a superconducting transition at 94 K, which was usually slightly higher than the starting oxide (YBa/sub 2/Cu/sub 3/O/sub 7/), while the hydride phases (H rich) are not superconducting. Infrared (IR), x-ray diffraction, and x-ray absorption spectroscopy (XAS) measurements indicate that H is located interstitially only near Cu sites.

15329 **Atom probe microanalysis of superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/.** Brenner, S.S.; Kellogg, G.L. (Sandia Nat. Labs., Albuquerque, NM (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/ needles prepared from hot-pressed discs of oxide powders were analyzed in a long drift-tube atom probe. An analyses was made from a randomly located area about 2 nm in diameter. Most of the oxygen field-evaporated as O/sub 2//sup +/ ions. The measured composition agreed well with that of YBa/sub 2/Cu/sub 3/O/sub 6.5/ except for yttrium which was found to be too high. The oxygen concentration profile showed fluctuations about 2.5 nm apart which must still be clarified.

15330 **Improved magnetization for YBa/sub 2/Cu/sub 3/O/sub 7-δ/ annealed in oxygen above 1000°C.** Venturini, E.L.; Ginley, D.S.; Baughman, R.J.; Morosin, B.; Kwak, J.F. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Air sintering and subsequent oxygen annealing at high temperatures are integral to the production of ceramic superconducting YBa/sub 2/Cu/sub 3/O/sub 7-δ/. The authors present results di-

rected toward optimizing the temperature for these two process steps, using static magnetization to determine the intragranular properties. Surprisingly, pure oxygen stabilizes the material against decomposition at temperatures near the melting point, allowing the production of significantly higher quality single phase material.

15331 **Local environment around barium atoms in the superconductor Y-Ba-Cu-O.** Krol, A.; Xu, F.; Jang, L.Y.; Sher, C.J.; Spagna, S.; Althoff, J.; Kao, Y.H. (State Univ. of N.Y. at Stony Brook, Stony Brook, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The local structure around Ba atoms in the compound superconductor Y-Ba-Cu-O has been studied by measuring the extended x-ray absorption fine structure (EXAFS) near the Ba K edge. This technique is used to investigate the changes in the short range order structure when the system is doped with impurities.

15332 **Simulation and processing of high resolution images of defects and interfaces in superconducting YBa/sub 2/Cu/sub 3/O/sub 7/.** Zandbergen, H.W.; Gronsky, R.; Wang, K.; Thomas, G. (Lawrence Berkeley Lab., Berkeley, CA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The superconducting performance, in particular the critical current, of polycrystalline YBa/sub 2/Cu/sub 3/O/sub 7/ will depend strongly on the structure of grain boundaries and the nature and number of defects in the microstructure. To characterize the atomic structure of defects and grain boundaries in these materials, a high resolution electron microscopy study has been initiated. Emphasis has been placed on the technique of phase contrast imaging with corresponding computer simulation and processing for optimum interpretation of results.

15333 **Grain boundaries, planar defects and superconducting properties of YBa/sub 2/Cu/sub 3/O/sub 7/.** Tafto, J.; Suenaga, M.; Wang, T.; Sabatini, R.L.; Moodenbaugh, A.R.; Levine, S. (Brookhaven Lab., Upton, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Polycrystalline samples of tetrogonal YBa/sub 2/Cu/sub 3/O/sub 6.25/ were transformed into the superconducting orthorhombic phase by annealing in an oxygen atmosphere at temperatures ranging from 400-850°C and then slowly cooled to room temperature (15°C/h). Transmission electron microscopy (TEM) images of these samples and samples prepared in the usual way show layers of amorphous or highly disordered material, several 100 nm thick, at a large fraction of the grain boundaries. Also all samples contain 10-100 nm thick sheets of disordered material which lie in the a-b planes and tend to run through the entire crystal grain. In the a-b planes the authors also observe dislocation loops, particularly in the as-quenched tetragonal samples and stacking faults in the heat-treated samples. The authors also frequently observe set of twins with orthogonal habit planes within a crystal grian. They attribute the low critical current density in YBa/sub 2/Cu/sub 3/O/sub 7/ to these planar faults and the disordered grain boundary regions, and discuss the TEM observations with reference to resistivity and inductive measurements.

15334 **High temperature superconductors in the La/sub 1+x/Ba/sub 2-x/Cu/sub 3/O/sub y/ system.** McCarron, E.M.; Torardi, C.C.; Attfield, J.P.; Morrissey, K.J.; Sleight, A.W.; Cox, D.E.; Bordia, R.K.; Farneth, W.E.; Flippen, R.B.; Subramanian, M.A. (Brookhaven Nat. Lab., Upton, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

In the perovskite-related La/Ba/Cu oxide system, the lanthanum ions can substitute on the barium sites due to a close match in the ionic radius of the two. Thus it is possible to make a solid solution La/sub 1+x/Ba/sub 2-x/Cu/sub 3/O/sub y/ where $0 - x \leqq 0.5$ and $y - 7$. For the Ba-rich end member composition ($x - 0$), the structure is orthorhombic, but as the La content increases and La begins to substitute on the Ba sites (disordered), the crystal symmetry changes from orthorhombic to tetragonal. In addition, the superconducting properties vary with increasing La content. In particular, the superconducting onset temperature is found to decrease linearly from 80 to 45 K over the compositional (x) range $0.0 \rightarrow 0.375$. In the La-rich limit ($x = 0.5$), 1/4 of the Ba atoms are replaced by La and superconductivity is lost. A correlation between oxygen ordering (annealing) and high T/sub c/ is observed for orthorhombic LaBa/sub 2/Cu/sub 3/O/sub y/ and inferred in the case of tetragonal La/sub 1.25/Ba/sub 1.75/Cu/sub 3/O/sub y/.

15335 **Superconductivity of La/sub (2-x)/Ba/sub x/CuO/sub 4/.** Moodenbaugh, A.R.; Xu, Y.; Suenaga, M. (Brookhaven Lab., Upton, NY (US)). pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Superconductivity near 30 K in the La-Ba-Cu-O system was soon found to be attributable to the K/sub 2/NiF/sub 4/-type (at room temperature) compound La/sub (2-x)/Ba/sub x/CuO/sub 4/. Substitution of Sr and Ca for Ba yielded superconducting systems, also with high superconducting transition temperature T/sub c/. Replacement of La by Y led to the discovery of the 90 K superconductors. Systematic investigations of the detailed superconducting behavior of the La-Ba-Cu-O system are few. Interest in higher T/sub c/'s understandably led most investigators elsewhere. Nonreproducible results, apparently due to problems with sample preparation, at least in our laboratory, also discouraged a prompt study of La/sub (2-x)/Ba/sub x/CuO/sub 4/. A review of the literature and the authors' own experience suggested improved methods for sample preparation. Others observed that in the La-Sr-Cu-O system, water is apparently incorporated into samples prepared normally. Fraction of superconductivity was reduced in samples exposed to water, unless steps were taken to remove the water before reaction took place. In our early work, a powder sample exposed to air for several days between heatings was only weakly superconducting, in contrast to the bulk superconductivity seen in similar materials processed promptly. Here too, water was apparently incorporated into the sample. Careful and systematic sample preparation described in detail below yielded a series of La/sub (2-x)/Ba/sub x/CuO/sub 4/ samples having consistent properties. The bulk superconducting transition temperatures show an unexpectedly strong variation with barium content. T/sub c/ rises to above 20 K at $x = 0.09$, dips to below 5 K at $x = 0.12$, then rises steeply to 25 K near $x = 0.15$. At $x = 0.215$ T/sub c/ is again down to 5 K.

15336 **Raman scattering studies on superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/, semiconducting YBa/sub 2/Cu/sub 3/O/sub 6+x/, and possible impurity phases.** Mascarenhas, A.; Katayama-Yoshida, H.; Geller, S.; Pankove, J.I.; Deb, S.K. (Solar Energy Research Institute, Golden, CO (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

A Raman spectroscopic investigation of specimens of superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/ and semiconducting YBa/sub 2/Cu/sub 3/O/sub 6+x/ indicates that in the range 100 to 700 cm/sup -1/, the characteristic lines of the superconductor at 13 K, are at 150, 338, 441, 507, 590, and 644 cm/sup -1/. Comparison of the Raman spectra of the superconductor and the semiconductor indicates a mode stiffening of the pair at 338 and 441 cm/sup -1/, but a mode softening of the pair at 507 and 590 cm/sup -1/. A factor group analysis leads to a tentative assignment of the Raman and infrared allowed modes. At temperatures 12K ≦ T ≦ 180K the Raman spectra of the superconductor indicate that the phonon mode at 338 cm/sup -1/ has an anomaloys temperature dependence below the superconducting critical temperature (T/sub c/).

15337 **Single-crystal structural study of La/sub 2/Cu/sub 0.95/Li/sub 0.05/O/sub 4/.** Delgado, J.M.; Speck, J.S.; McMullan, R.K.; Diaz de Delgado, G.; Wuensch, B.J. (Dept. of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

A large crystal of flux-grown La/sub 2/CuO/sub 4/, examined through single-crystal neutron diffraction, was found to have an orthorhombic superstructure derived from the K/sub 2/NiF/sub 4/ structure type with a=5.359(1), b=5.363(1), c=13.127(2) A. The pattern of systematically absent intensities indicated space group Pccn but meaningful refinement of thermal vibration parameters could not be obtained in this symmetry. Systematic examination of all possible orthorhombic subgroups of Fmmm yielded satisfactory refinement to R(F/sup 2/)=2.57% only in space group Bmab. Incorporation in the crystal of Li derived from the flux results in an orthorhombic distortion smaller than found for pure La/sub 2/CuO/sub 4/. Refinement of the Cu site occupancy provided Cu/sub 0.950/Li/sub 0.050(3)/, in excellent accord with a bulk chemical analysis. Reflections which violate the systematic absences of Bmab are attributed to a smaller volume fraction of domains in orientation twinned by 90° rotation about c. This interpretation is supported by transmission electron microscopy which revealed intergrown lamellae. Dark field imaging with a forbidden reflection illuminated only the twin lamellae.

15338 **Oxygen order, stoichiometry and magnetic behavior of YBa/sub 2/(Cu/sub 1-x/Fe/sub x/)/sub 3/O/sub 7+δ/.** Kimball, C.W.; Matykiewicz, J.L.; Giapintzakis, J.; Lee, H.; Dunlap, B.D.; Slaski, M.; Fradin, F.Y.; Segre, C.; Jorgensen, J.D. (Argonne Nat. Lab., Argonne, IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitzawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Mossbauer effect and neutron diffraction measurements have been made as a function of composition for YBa/sub 2/(Cu/sub 1-x/Fe/sub x/)/sub 3/O/sub 7/ + δ. A chemically driven disordering of the sublattices is observed with increasing Fe concentration which results in a transition from the orthorhombic to a tetragonal phase. However, as the occupancy of the oxygen site O(1) in the chain is depleted and the site of the ordered vacancy O(5) between the chains becomes occupied, the total oxygen content is not reduced but remains near seven in contrast to behavior observed in the quenched tetragonal phases. Mossbauer spectra for x = 0.05 at temperatures below 15K show magnetic hyperfine splitting which is characteristic of a spin glass; i.e., a distribution of magnetic fields. It is inferred from Mossbauer results that Fe preferentially occupies the Cu(1) site.

15339 **X-ray absorption and resistivity studies of the quinary-compound superconductor Y-Ba-Cu-O-S.** Spagna, S.; Althoff, J.; Yao, Y.D.; Xu, F.; Jang, L.Y.; Krol, A.; Kao, Y.H. (State Univ. of N.Y. at Stony Brook, Stony Brook, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

A quinary-compound system consisting of Y, Ba, Cu, O, and S has been prepared in the authors' laboratory. The nominal composition of Y, Ba, Cu, and O is similar to the well known material YBa/sub 2/Cu/sub 3/O/sub 7-y/; the addition of S is intended to partially substitute the O sites. X-ray absorption measurements show that the lattice is distorted with the presence of S atoms. The transition temperature is found to decrease from 93K to about 77K with an increasing S content up to S/Cu concentration ratio near 0.25; further increase of S results in unstable superconducting behavior and very broad resistive transition.

15340 **Magnetic investigations of superconductive, polycrystalline (RE)/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-x/ compounds (RE = Y, Gd, Ho, Dy).** Thompson, J.R.; Boatner, L.A.; Brynestad, J.; Christen, D.K.; Kim, Y.C.; Sales, B.C.; Sekula, S.T. (Oak Ridge Nat. Lab., Oak Ridge, TN (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Magnetic properties have been investigated for several rare-earth based, polycrystalline samples of high T/sub c/ superconductive "123" compounds with magnetic onset temperatures between 90 and 95 K. Analysis of the susceptibility x of samples based on Gd, Ho, and Dy indicates that the superconductive and magnetic properties are independent of one another to a substantial degree. Studies of the critical current density J/sub c/ are reported.

15341 **Photoemission study of the electronic structure of copper oxide superconductors.** Shen, Z.X.; Allen, J.W.; Yeh, J.J.; Kang, J.S.; Ellis, W.; Spicer, W.E.; Lindau, I.; Sun, J.Z.; Geballe, T.H.; Maple, M.B. (Stanford Electronics Labs., Stanford Univ., Stanford, CA (US)). pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The authors report the photoemission spectra from a high quality thin film sample of Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-δ/ at room temperature and bulk samples of Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-δ/ at different temperatures. The experimental data are interpreted within the configuration interaction model of Anderson Hamiltonian. The experimental values for Δ, U and T are determined. The authors also give the reasons why they think PES data reflect the intrinsic property of the superconductors. Furthermore, they emphasize the importance of the presence of a 3d/sup 8/-like satellite which signals the strong correlation among 3d electrons.

15342 **Grain boundary segregation and thermal history effects on properties of La/sub 1.85/Sr/sub 0.15/CuO/sub 4-y/ superconductors.** Chiang, Y.M.; Roshko, A.; Fabes, B.D.; Leung, D.K.; Ikeda, J.A.S.; Rudman, D.A.; Parker, M.J.; Martin, J.R. (Dept. of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The grain boundary segregation of Sr in the La/sub 1.85/Sr/sub 0.15/CuO/sub 4-y/ system, and its effects on polycrystalline diamagnetic properties, have been characterized. Equilibration at 1000°C reduces grain boundary segregation compared to that

which is present at 700°C. Results indicate that critical currents in randomly oriented polycrystalline materials are improved if annealing treatments are optimized to minimize grain boundary segregation without degrading lattice oxygen stoichiometry.

15343 **Optical reflectance studies on YBa/sub 2/Cu/sub 3/O/sub 7-x/ and related compounds.** Kamaras, K.; Doss, M.G.; Herr, S.L.; Kim, J.S.; Porter, C.D.; Stewart, G.R.; Tanner, D.B.; Bonn, D.A.; Greedan, J.E.; O'Reilly, A.H. (Dept. of Physics, Univ. of Florida, Gainesville, FL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Optical reflectance spectra in the range 30-35000 cm/sup -1/ and 4-300 K are presented on several YBa/sub 2/Cu/sub x/O/sub y/ phases, as well as different forms of the superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/ phases (polycrystalline pellets, textured pellets with ab-plane oriented surface, and single crystals).

15344 **Electron scattering in superconducting oxides.** Ruvalds, J.; Ishii, Y. (Physics Dept., Univ. of Virginia, Charlottesville, VA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Electron energy loss measurements on superconducting oxides are correlated with an acoustic plasmon branch whose energy and width is highly sensitive to the alloy composition. Changing oxygen content reveals structure in the electron cross section which tracks the changes in the superconducting transition temperature.

15345 **Copper valence via small polaron analysis in sinter-forged YBa/sub z/Cu/sub 3/O/sub 7-y/ at 700°C.** Ahuja, A.; Dorris, S.E.; Su, M.Y.; Robinson, Q.; Johnson, D.L.; Mason, T.O. (Argonne Nat. Lab., Argonne, IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Via electrical property measurements (conductivity, thermopower) at 700°C on sinter-forged YBa/sub z/Cu/sub 3/O/sub 7-y/, it was determined that conduction occurs via small polaron conduction in the tetragonal phase. From the thermopower and oxygen content the distribution of copper valence states was determined.

15346 **Differential scanning calorimetry and Guinier camera/high-temperature x-ray diffraction studies of the oxygen sublattice phase transition in the YBa/sub 2/Cu/sub 3/O/sub 7-x/ system.** Lee, D.S.; Fu, Z.; Hellstern, E.; Johnson, W.L.; Pietrokowsky, P.; Samwer, K. (California Institute of Technology, Keck Lab. of Engineering Materials, Pasadena, CA (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The authors have studied the phase transition of the oxygen sublattice in the YBa/sub 2/Cu/sub 3/O/sub 7-x/ system by Differential Scanning Calorimetry (DSC), Guinier Camera, and high temperature x-ray diffraction (ht-xrd) techniques. The transition was examined under different thermodynamic constraints (constant oxygen partial pressure and constant oxygen concentration) and for a range of oxygen partial pressures. The variation of the endothermic peak temperature with DSC scanning rate was used to deduce an activation energy for the transition. The average activation energy for the process is between 38.7 - 75.0 kcal/mole(1:2:3) [mole], depending on the thermodynamic constraint imposed on the system. Pressure versus concentration isotherms (P(C)) were used to determine the chemical potential of the oxygen in this system.

15347 **Thermogravimetric studies on Ba/sub 2/YCu/sub 3/O/sub 7-x/.** Brannon, C.J.; Anderson, H.U.; Sparlin, D.M. (Ceramic Engineering and Physics Dept., Univ. of Missouri-Rolla, Rolla, MO (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The recently discovered high transition temperature superconducting oxide Ba/sub 2/YCu/sub 3/O/sub 7-x/ is a p-type psuedoperovskite with ordered oxygen defects. The normal state conductivity is treated in terms of equilibrium defect concentrations is treated in terms of equilibrium defect concentrations using a modified Verway model.

15348 **Thermochemistry and high temperature thermodynamic properties of rare earth-alkaline earth-copper oxide superconductors.** Morss, L.R.; Sonnenberger, D.C.; Thorn, R.J. (Argonne Nat. Lab., Argonne, IL (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Enthalpies of formation of the perovskite-related oxides, La/sub 1.85/Sr/sub 0.15/CuO/sub 4/, YBa/sub 2/Cu/sub 3/O/sub y/, with y = 6.93, 6.69, and 6.47 have been determined at 298.15 K by perchloric acid solution calorimetry. Enthalpies of formation and free energies of reactions with H/sub 2/O(g) and CO/sub 2/(g) have been evaluated. The partial molar enthalpy of solution of oxygen in YBa/sub 2/Cu/sub 3/O/sub y/ has been determined and compared with values derived from measurements of the equilibrium partial vapor pressures of oxygen. The significance of the defect state thermochemistry in conductivity is identified.

15349 **Effects and behavior of implanted fluorine in high temperature superconductors.** Tesmer, J.R.; Maggiore, C.J.; Nastasi, M.; Cheong, S.W.; Dick, C.M. (Los Alamos Nat. Lab., Los Alamos, NM (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The effects of implanted fluorine on the resistivity of high temperature superconductors and its diffusion within the superconductors have been studied in an attempt to duplicate a recent report of enhanced critical temperatures. Implanted fluorine was found to have no effect on the critical temperature and, upon heating, the fluorine diffuses out of the near surface.

15350 **Orientation dependent x-ray absorption near edge structure in YBa/sub 2/Cu/sub 3/O/sub 7/ and La/sub 1.85/Sr/sub 0.15/CuO/sub 4/.** Heald, S.M.; Tranquada, J.M.; Moodenbaugh, A.R.; Xu, Y. (Brookhaven Nat. Lab., Upton, NY (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

X-ray absorption measurements have been made on powder samples of YBa/sub 2/Cu/sub 3/O/sub 7/ and La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ oriented in a magnetic field. Measurements made at the Cu K edge with the x-ray polarization oriented perpendicular and parallel to the c-axis show distinct differences for both materials, indicating a strong anisotropy of the electronic states about the Cu atoms. The Y Edge measurements show a much smaller anisotropy as expected due to its more symmetric environment. Preliminary analysis indicates these measurements should be useful in choosing between the conflicting interpretations of the near edge structure in these materials.

15351 **Effects of X irradiation and high field electron injection of the electrical properties of rapid thermal oxides.** Schubert, W.K.; Seager, C.H. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Rapid thermal oxidation (RTO) is a promising tool for fabricating the thin gate oxides (5 to 15 nm) that will be needed in future submicron integrated circuits, because of its inherently superior time-temperature control when compared to conventional oxidation methods. It is important to demonstrate that RTO can be used without adversely affecting the radiation hardness or high field properties of the oxide. Beyond this demonstration, rapid thermal processing makes it possible to determine more precisely how the kinetics of oxidation and post oxidation annealing affect the device properties. Information of this type should prove useful in modeling relevant defect formation mechanisms. The present paper is part of a systematic study of the effect of rapid thermal processing on the radiation and high field response of thin oxides.

15352 **Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging.** Ellingson, W.A.; Ackerman, J.L.; Garrido, L.; Weyand, J.D.; DiMilia, R.A. (Materials and Components Div., Argonne National Lab., Argonne, IL (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

The characterization of advanced ceramics presents a challenge to conventional nondestructive evaluation techniques. Small bulk density gradients, caused mainly by porosity differences, may lead to failure. Specimens were prepared from Al/sub 2/O/sub 3/ powder and processed to different density states. The specimens ranged in density from as-pressed to nominally 90% theoretical density. The relative porosity levels were measured by a small-bore nuclear magnetic resonance (NMR) imaging system. The results demonstrate the potential of NMR for characterizing open porosity in ceramic bodies.

15353 **Microwave sintering of Al/sub 2/O/sub 3/ and Al/sub 2/O/sub 3/-SiC whisker composites.** Meek, T.T.; Blake, R.D.; Petrovic, J.J. (Materials Science and Technology Div., Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Alumina-based ceramics can be rapidly heated to high temperatures using microwave radiation. Initial investigations have been performed on the microwave sintering of Al/sub 2/O/sub 3/ and Al/sub 2/O/sub 3/-SiC whisker ceramic composites at 60 GHz. High purity submicron Al/sub 2/O/sub 3/ powders were observed to sinter from an initial green density of 50% to a sintered density of 96%, when specimens were microwave heated at 60 GHz from room temperature of 1700°C in 370 s. SiC whisker-Al/sub 2/O/sub 3/ matrix ceramic composites containing 10 vol% whiskers were sintered for 52% initial density to 77% sintered density, by microwave heating at 60 GHz from room temperature to 1450°C in 320 s.

15354 **Fiber-reinforced ceramic composites.** Moeller, H.H.; Long, W.G.; Caputo, A.J.; Lowden, R.A. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Ceramic fiber ceramic composites have been fabricated by a novel chemical vapor infiltration process. Silicon carbide fiber-reinforced silicon carbide tubes were fabricated and tested. This material exhibits non-brittle fracture and excellent strength at room-temperature, 1000°C and 1200°C.

15355 **Model for CVI of short fiber preforms.** Starr, T.L. (Georgia Tech Research Inst., Georgia Institute of Technology, Atlanta, GA (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Ceramic matrix composites can be fabricated by chemical vapor infiltration (CVI) of a fibrous preform. Typical isothermal processing of such materials requires several weeks to achieve high density. Development of a forced flow, thermal gradient technique can reduce infiltration time to several h. A microstructural model for the fibrous preform and the intermediate partially densified composite is used to predict gas flow and temperature throughout the body. When combined with kinetics data, this model will allow optimization of processing conditions and composite structure and properties. Figure 1 shows the overall scheme for this model.

15356 **Ceramic composite heat exchanger.** Cole, W.E.; Reagan, P.; Metcalfe, C.I.; Wysk, S.R.; Jones, K.W. (EG and G Idaho, Inc., Idaho Falls, ID (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

A novel concept for a high-temperature heat exchanger has been developed utilizing a ceramic composite material for application in industrial environments. Forming, shaping, and weaving techniques of the ceramic cloth substrate allow one-piece construction of a heat-exchanger panel which contains both headers and flow passages. This woven substrate is coated with silicon carbide by chemical vapor deposition (CVD) to form a leak-tight panel. The heat exchanger is designed to operate in a corrosive flue environment to preheat combustion air to 1100°C.

15357 **Reaction-sintered silicon nitride composites with short fiber reinforcement.** Starr, T.L.; Harris, J.N.; Mohr, D.L. (Georgia Tech Research Inst., Georgia Institute of Technology, Atlanta, GA (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

The addition of short fibers or whiskers can increase the fracture toughness of ceramics and increase their reliability as high temperature structural materials. Applications in fossil energy conversion will involve relatively large components for which scalable and near-net-shape fabrication techniques are particularly important. Slip-cast reaction sintered silicon nitride meets these requirements and, if successfully toughened by short fiber additions, would be a promising material for such applications.

15358 **SiC whisker-MoSi/sub 2/ matrix composites.** Gibbs, W.S.; Petrovic, J.J.; Honnell, R.E. (Materials Science and Technology Div., Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Whisker reinforcement was investigated as a means to improve mechanical properties. Vapor-liquid-solid (VLS) SiC whisker-MoSi/sub 2/ matrix composites containing 20 vol% whiskers were fabricated by conventional hot pressing techniques. In this system, whisker reinforcement toughen the material at low temperatures when the matrix is brittle and strengthen the material at

elevated temperatures when the matrix is ductile. At composite fabrication temperatures (1500-1700°C) SiC and MoSi/sub 2/ do not react. For such high fabrication temperatures, SiC whiskers are currently the only fiber reinforcement material suitable for composite synthesis. No reaction between the MoSi/sub 2/ matrix and the SiC whiskers was observed as a result of hot pressing at 1600°C.

15359 **Structure imaging and defects in crystallized oxynitride glasses.** Rai, R.S.; O'Keefe, M.A.; Thomas, G. (Ohio State Univ., Columbus, OH (US));. pp v of Characterization of defects in materials. Siegel, R.W.; Weertman, J.R.; Sinclair, R. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

High resolution electron microscopy has been employed to elucidate fault defects and structural details of the δ/sub 1/ and δ/sub 2/-Y/sub 2/Si/sub 2/O/sub 7/ crystalline phases. From this study δ/sub 1/ and δ/sub 2/-Y/sub 2/Si/sub 2/O/sub 7/ have been found to be orthorhombic having the same cell parameters but different atomic arrangements due to a change in their space groups. Computer simulations were necessary for interpreting details from the high resolution electron micrographs.

15360 **Fracture mechanics characterization of crack/fiber interactions in ceramic matrix composites.** Coyle, T.W.; Fuller, E.R. Jr.; Swanson, P.; Palamides, T. (Ceramics Div., Inst. Materials Sci. and Eng., National Bureau of Standards, Gaithersburg, MD (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

A crucial factor in the structural performance of ceramic matrix composites is the influence of the fiber/matrix bond on the interaction of a matrix crack with the reinforcing fibers. To elucidate the character of this interaction under controlled fracture conditions, glass fracture mechanics specimens were fabricated in the double-cleavage, drilled compression configuration with simple arrays of fibers. Propagating cracks were observed in cross-polarized illumination to characterize delamination of the fiber ahead of the crack and bridging interactions behind the crack tip. Stress wave fractography was employed to analyze the shape and relative velocity of the crack front.

15361 **Dynamic and static fatigue behavior of sintered silicon nitrides.** Chang, J.; Khandelwal, P.; Heitman, P.W. (Allison Gas Turbine, G.M. Corp., PO Box 420, Indianapolis, IN (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

The dynamic and static fatigue behavior of Kyocera SN220M sintered silicon nitride at 1000°C was studied. Fractographic analysis of the material failing in dynamic fatigue revealed the presence of slow crack growth (SCG) at stressing rates below 41 MPa/min (6 ksi/min). Under conditions of static fatigue this material also displayed SCG at stresses below 345 MPa (50 ksi). Slow crack growth appears to be controlled by microcracking of the grain boundaries. The crack velocity exponent (n) determined from both dynamic and static fatigue ranged from 11 to 16.

15362 **High temperature mechanical properties of SiAlON ceramic.** Chen, C.F.; Chuang, T.J. (Dept. of Materials Sci. and Engineering, The Univ. of Michigan, Ann Arbor, MI (US)). pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Creep resistance of an annealed β/sub 10/-7G SiAlON at 1170°C was characterized as a function of applied stress. By using a statistical least square method to minimize the differences between predicted and measured creep rates, different power law creep parameters for simple tension and simple compression were obtained. The agreements between measured migration of neutral axes and theoretical predictions further confirm the estimated values. The results suggest that a high stress exponent of ~ 14 for tension is possibly due to cavitational damage coupled with underlying materials creep; whereas the stress exponent of ~ 1 for compression can be attributed soley to linear viscous flow of grain boundary YAG phase.

15363 **High temperature mechanical properties of SiAlON ceramics.** Chen, C.F.; Tien, T.Y. (Dept. of Materials Sci. and Eng., Univ. of Michigan, Ann Arbor, MI (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Tensile creep of both as hot pressed and annealed SiAlON-YAG ceramics has been identified as creep damage (cavitation and cavity growth) mechanism. The hot-pressed sample has β-SiAlON grain as the crystalline phase surrounded by a vitreous matrix. When this material sustains creep, cavities nucleate within the multigrain junctions and the majority of cavities are followed by viscous flow growth. However, the annealed sample has β-SiAlON grain surrounded by crystalline YAG. When this material sustains creep, cavities nucleate at the interphase of SiAlON and YAG phases and the majority of cavities are followed by diffusive crack growth. Creep curves and TEM investigation shows that crystallizing the grain boundary vitreous phase can increase the creep life by reducing cavitation rate and cavity growth rate. Also, increasing the hot pressing time can affect creep behavior by reducing the number of multigrain junctions, thus, decrease cavitation rate.

15364 **Mechanical properties of silicon carbide whisker/aluminum oxide matrix composites.** Vaughn, W.L.; Homeny, J.; Ferber, M.K. (Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, IL (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

The mechanical properties of two SiC whisker/Al/sub 2/O/sub 3/ matrix composites were investigated as a function of whisker type. Composites were produced with both Silar SC-9 and Tateho SCW-1-S whiskers. The composites produced with the Silar SC-9 whiskers exhibited a fracture strength of 641 MPa and a fracture toughness of 8.7 MPa . m/sup 1/2/. Transmission electron microscopy examination of the whisker/matrix interfacial regions indicated that no significant chemical reactions had taken place during processing. Scanning electron microscopy examination of the fracture surfaces revealed limited whisker pullout for the composites produced with the Silar-SC-9 whiskers and no evidence of whisker pullout for the composites produced with the Tateho SCW-1-S whiskers. Analysis of toughening mechanisms indicated that whisker bridging and pullout processes may contribute to the enhanced fracture toughness for the composites produced with the Silar-SC-9 whiskers.

15365 **Corrosion reactions in SiC ceramics.** Tighe, N.J.; Sun, J.; Hu, R.M. (Ceramics Div., Inst. for Materials Sci. and Eng., National Bureau of Standards, Gaithersburg, MD (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

Corrosion reactions between SiC ceramics and molten sodium carbonate were studied used analytical scanning transmission electron microscopy. Thin film studies were used to identify interfacial reactions and compositions of corrosion scales. Thin foils were made from SiC samples before and after corrosion in NaCO/sub 3/ at 1000°C for exposure times of 5 min to 48 h. Sodium sili-

cate glass and clusters of silica platelets were found near the corrosion interfaces.

15366 Metal particle-toughened borosilicate sealing glass. Moore, R.H.; Kunz, S.C. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the ACS 11th annual conference on composites and advanced ceramic materials. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870172—).

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

The addition of metal particles to a borosilicate sealing glass increases the fracture toughness up to a factor of 4, depending on the volume percent and surface treatment of the particles. Improved glass-to-metal bonding is achieved by controlled oxidation and chemical etching of the metal particles. The toughness enhancement is explained in terms of the particle/matrix bond and crack deflection.

15367 Refractory films from spin-cast polyacrylonitrile. Renschler, C.L.; Sylwester, A.P. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Polyacrylonitrile (PAN) films have been spin-cast and pyrolyzed to produce thin (500-1500 A) carbon films. These films have higher electrical conductivities than carbon films produced by other methods at similar temperatures. The conductivity can be varied by at least four orders of magnitude by changing the pyrolysis temperature. UV, IR, and Raman spectroscopies were used to investigate the chemical structure of the films during different stages of processing.

15368 Chemical vapor deposited boron carbide. Mackinnon, I.D.R.; Smith, K.L. (Dept. of Geology, Univ. of New Mexico, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Detailed analytical electron microscope (AEM) studies of yellow whiskers produced by chemical vapor deposition (CVD) show that two basic types of whiskers are produced at low temperatures (between 1200°C and 1400°C) and low boron to carbon gas ratios. Both whisker types show planar microstructures such as twin planes and stacking faults oriented parallel to, or at a rhombohedral angle to, the growth direction. For both whisker types, the presence of droplet-like terminations containing both Si and Ni indicate that the growth process during CVD is via a vapor-liquid-solid (VLS) mechanisms.

15369 Preparation of boron-rich refractory semiconductors. Aselage, T.L. (Electronic Ceramics Div. 1842, Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Boron-rich refractory solids based on the rhombohedral structure of α-B exhibit electrical properties that range from a hopping-type semiconductor (boron carbide) to wide bandgap room temperature insulators (the boron pnictides B/sub 6/P and B/sub 6/As). As such, they are of interest for a variety of high temperature semiconductor applications. Preparation techniques for these unusual materials are reviewed, and new results on the crystal growth of boron carbides and B/sub 6/As and on thin film deposition of B/sub 6/P are presented.

15370 Anomalous Seebeck coefficient in boron carbides. Aselage, T.L.; Emin, D.; Wood, C.; Mackinnon, I.D.R.; Howard, I.A. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Boron carbides exhibit an anomalously large Seebeck coefficient with a temperature coefficient that is characteristic of polaronic hopping between inequivalent sites. The inequivalence in the sites is associated with disorder in the solid. The temperature dependence of the Seebeck coefficient for materials prepared by different techniques provides insight into the nature of the disorder.

15371 Electronic transport properties of hot-pressed B/sub 6/Si. Wood, C.; Emin, D.; Feigelson, R.S.; Mackinnon, I.D.R. (Jet Propulsion Lab., Pasadena, CA (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Measurements of the electrical conductivity, Seebeck coefficient and Hall mobility from —300 K to —1300 K have been carried out on multiphase hotpressed samples of the nominal composition B/sub 6/Si. In all samples the conductivity and the p-type Seebeck coefficient both increase smoothly with increasing temperature. By themselves, these facts suggest small-polaronic hopping between inequivalent sites. The measured Hall mobilities are always low, but vary in sign. A possible explanation is offered for this anomalous behavior.

15372 Bipolaron formation in B/sub 12/ and (B/sub 11/C)/sup +/ icosahedra. Howard, I.A.; Beckel, C.L.; Emin, D. (Dept. of Physics and Astronomy, Univ. of New Mexico, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Boron carbides, B/sub 1-x/C/sub x/ with $0.085 \leqq x \leqq 0.200$, generally contain both B/sub 12/ and B/sub 11/C icosahedra. However, the electronic transport with $0.1 \leqq x \leqq 0.2$ is believed to occur by means of bipolaron hopping between only B/sub 11/C icosahedra. The authors have calculated the changes in energy, atomic positions and charge distribution when a pair of electrons is added to the isoelectronic icosahedral clusters B/sub 12/ and (B/sub 11/C)/sup +/. They simulate an icosahedron in a neutral lattice by bonding the icosahedral atoms to hydrogenic atoms which the authors constrain to be neutral. The computations are performed with a self-consistent molecular-orbital method, PRDDO. They find a total energy reduction of — 3.7 eV for two electrons added to a B/sub 12/ icosahedron. Of this, — 2.7 eV arises from the electrons filling the icosahedron's bonding orbitals. The remaining — 1.0 eV comes from the contraction of the icosahedron's radius by — 0.09 A. For two electrons added to a (B/sub 11/C)/sup +/ icosahedron the authors find a total energy reduction of — 18.2 eV. Of this, — 16.5 eV arises from filling the icosahedron's bonding orbitals. The remainder arises from a — 0.09 A contraction of the icosahedron's radius. Thus, the authors find (B/sub 11/C)/sup +/ icosahedra to be strongly energetically favored over B/sub 12/ icosahedra as bipolaron sites. The positive charge associated with a (B/sub 11/C)/sup +/ icosahedron is distributed over the eleven boron atoms. Concomitantly, they find the added two electrons of the bipolaron to be distributed over all twelve sites of the B/sub 11/C icosahedron. They find the energy difference between an electron pair added to B/sub 12/ and (B/sub 11/C)/sup +/ icosahedra to arise principally from the increased Coulombic attraction provided by the extra positive charge of the (B/sub 11/C)/sup +/ icosahedron.

15373 **Electronic structure of boron and boron-rich borides.** Switendick, A.C. (Solid State Theory Div. 1151, Sandia National Labs., PO Box 5800, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The author has calculated the electronic structure of cubic B/sub 12/ and B/sub 12/P/sub 2/ using the linear augmented plane wave method. These calculations are self-consistent and include calculation of the total energy. Within the strict muffin tin approximation (spheres centered only on atomic positions-constant potential otherwise) these systems are unbound with respect to the atomic constituents. Using interstitial spheres, up to 77% of the unit cell can easily be filled to yield much more reasonable total energies. Although the improvement in the total energy is significant upon including the interstitial spheres, the band structure and densities of states are not significantly changed. Similarly, the real atomic charge distributions (B, P) are little changed, while the interstitial distribution does change to reflect the additional freedom provided by the interstitial spheres. Results including the rhombohedral and icosohedral distortions in both systems are discussed. Gaps are found to open up in the alpha rhombohedral boron and in the B/sub 12/P/sub 2/ systems as are observed experimentally.

15374 **Origin of paramagnetic defect in single crystal and ceramic B/sub 4/C.** Venturini, E.L.; Emin, D.; Aselage, T.L. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The authors compare electron spin resonance (ESR) spectra of B/sub 4/C samples made by three methods. The samples are 1) two ceramics made by hot-pressing boron and carbon powders, 2) a polycrystal made by carbothermic reduction, and 3) a single crystal grown from a palladium metal melt. All samples show remarkably similar spectra between 2 and 100 K. In particular, all samples show a single Lorentzian absorption, a linewidth that decreases with increasing temperature, and an inverse temperature dependence of the integrated intensity. The integrated intensity of the paramagnetic spin signal corresponds to a density of 2x10/sup 19// cm/sup 3/ localized spins. Having a single crystal sample enables us to meaningfully measure the angular dependence of the ESR linewidth. This angular dependence is consistent with the paramagnetic centers being unpaired electrons centered on the central carbon atoms of positively charged C-C-C intericosahedral chains. These chains appear to replace 0.5% of the positively charged C-B-C intercosahedral chains which occur in B/sub 4/C.

15375 **A comparison of calculated and experimental HRTEM images for twinned boron carbide.** Miller, M.L.; Mackinnon, I.D.R. (Dept. of Geology, Univ. of New Mexico, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

High resolution TEM images of boron carbide (B/sub 13/C/sub 2/) have been recorded and compared with images calculated using the multislice method as implemented by M.A. O'Keefe in the SHRLI programs. Images calculated for the [010] zone, using machine parameters for the JEOL 2000FX AEM operating at 200 keV, indicate that for the structure model of Will et al., the optimum defocus image can be interpreted such that white spots correspond to B/sub 12/ icosahedra for thin specimens and to low density channels through the structure adjacent to the direct inter-icosahedral bonds for specimens of intermediate thickness (-40 > t > -100 nm). With this information, and from the symmetry observed in the TEM images, it is likely that the (101) twin plane passes through the center of icosahedron located at the origin. This model was tested using the method of periodic continuation. Resulting images compare favorably with experimental images, thus supporting the structural model. The introduction of a (101) twin plane through the origin creates distortions to the icosahedral linkages as well as to the intra-icosahedral bonding. This increases the inequivalence of adjacent icosahedral sites along the twin plane, and thereby increases the likelihood of bipolaron hopping.

15376 **Crystal structure refinements of rhombohedral symmetry materials containing boron-rich icosahedra.** Morosin, B.; Aselage, T.L.; Feigelson, R.S. (Sandia National Labs., PO Box 5800, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The crystal structures of several icosahedral boron-containing compounds have been refined using MoKα intensity data. Preparation of crystals differ from previous procedures, with boron carbide grown from molten copper and boron arsenide by arsenic vapor transport. The structures consist of icosahedral units bonded together with direct B-B bonds as well as other linkage units (B-C-B and As-As chains).

15377 **Atomic interactions in a boron-rich carbon-containing icosahedron.** Beckel, C.L.; Obarski, G.E.; Fuka, M.Z.; Fritts, J.D. (Dept. of Physics and Astronomy, Univ. of New Mexico, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Boron carbides contain carbon atoms as substituents for boron in icosahedra. The B-C interaction is different in icosahedra from that in other geometric forms. Para-carborane, p-C/sub 2/B/sub 10/H/sub 12/, offers an excellent system for the study of structure and interactions in boron-rich, carbon-containing icosahedra; its structure is well-characterized experimentally, and the infrared and Raman spectra have been observed and are relatively simple. Here they present an analysis of p-carborane by classical force field methods supplemented by quantum mechanical calculations. Complexity in the model cluster is introduced step-by-step beginning with B/sub 12/ (I/sub h/ symmetry). The principle interaction constants extracted through interpretation of p-C/sub 2/B/sub 10/H/sub 12/ spectra are k/sub CB/ = 2.0 x 10/sup 5/ dyne/cm k/sub BB/ (intrapentagon) = 1.3 x 10/sup 5/ dyne/cm, and k/sub BB/ (interpentagon) - 1.55 x 10/sup 5/ dyne/cm.

15378 **Growth, doping, device development and characterization of CVD beta-SiC epilayers on Si(100) and alpha-SiC(0001).** Kong, H.; Kim, H.J.; Edmond, J.A.; Palmour, J.W.; Ryu, J.; Carter, C.H. Jr.; Glass, J.T.; Davis, R.F. (North Carolina State Univ., Dept. of Materials Science and Engineering, Box 7907, Raleigh, NC (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Monocrystalline β-SiC films have been chemically vapor deposited on Si(100) and α-SiC(0001) at 1660K-1823K and 0.1 MPa using SiH/sub 4/ and C/sub 2/H/sub 4/ carried in H/sub 2/. Films grown directly on Si(100) contained substantial concentrations of dislocations, stacking faults and antiphase boundaries (APB); those on α-SiC(0001) contained double positioning boundaries. Both the APBs and the double positioning boundaries were eliminated by using off-axis orientations of the respective substrates. Films produced on Si(100) have also been doped during growth and via ion implantation with B or Al (p-type) or P or N (n-type) at LN, room and elevated temperatures. Results from the former procedure showed the ionized dopant/total dopant concentration ratios for N, P, B and Al to be 0.1, 0.2, 0.002 and 0.01, respectively. The solubility limits of N, P and B at 1660K were determined to be — 2E20, 1E18 and 8E18 cm/sup -3/, respectively; that of Al exceeds 2E19 cm/sup -3/. High temperature ion implantation coupled with dynamic and post annealing resulted in a markedly reduced defect concentration relative to that observed in similar research at the

lower temperatures. Schottky diodes, p-n junctions, and MOSFET devices have been fabricated. The p-n junctions have been characteristics of insulators containing free carriers and deep level traps. The MOSFETs show very good I-V characteristics up to 673K, but have not been optimized.

15379 **Low-carbon boron carbides produced by CVD.** Campbell, A.N.; Mullendore, A.W.; Tallant, D.R.; Wood, C. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Boron carbides with low C contents were produced from BCl/sub 3/ and CCl/sub 4/ by chemical vapor deposition at temperatures of 1020-1500°C. The deposits were found to be between B/sub 13/C/sub 2/ and B/sub 11/C (8.3 to 13.3 at %C) in composition by means of Auger electron spectroscopy. Raman spectroscopy demonstrates that the specimens contain very little free carbon. Further, disordering of C in the chains and icosahedra of the rhombohedral boron carbide structure for C contents of less than 20 at. % is indicated by the Raman results. Single-phase rhombohedral boron carbides with C contents as low as 12.5 at % (≃B/sub 7/C) have been produced. The most B-rich specimens, containing 8.3 at % (B/sub 11/C) or less C, were phase separated. At least one of the phases in the phase separated specimens is tetragonal. The electrical conductivity and Hall mobility of the B/sub 11/C specimen are reported.

15380 **Stresses in oxide films and relationships with cracking and spalling.** Evans, A.G.; Cannon, R.M. (Materials Program, College of Engineering, Univ. of California, Santa Barbara, CA (US));. pp v of Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-861076—).

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

The considerations involved in determining the stresses in oxide films are reviewed. Accordingly, the sign and magnitude of the stress are shown to depend upon such variables as the interface coherency, the oxide microstructure, the surface curvature and the relevant diffusion parameters. In addition, the presence of stress concentrations at geometric discontinuities in the film is demonstrated. Mechanisms of cracking and spalling in stressed films are analyzed by describing the mechanics pertinent to cracks in the film or at the interface. Trends in cracking with film thickness and fracture resistance, as well as with the magnitude of the residual stress are thereby elucidated.

15381 **Icosahedral boron-rich solids as refractory semiconductors.** Emin, D. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Icosahedral boron-rich solids are refractory materials composed of twelve-atom boron-rich icosahedral units with strong intericosahedral linkages. These distinctive structures admit unusual electronic and thermal transport properties. Here the distinctive (three-center) bonding which underlies these materials is first described. Then it is shown how insulators, semiconductors and highly degenerate (metal-like) materials emerge from the same basic structure with appropriate substitutions. The electronic transport of the boron carbides is then addressed. The boron carbides are degenerate p-type semiconductors in which the charge carriers are diamagnetically aligned pairs of electrons which hop between icosahedra. Uniquely, this thermally activated hopping conductivity increases with increasing hydrostatic pressure. However, the Seebeck coefficient (thermoelectric power) is uncharacteristic of a degenerate semiconductor. Namely, the Seebeck coefficient is typically both large and an increasing function of temperature. In addition, despite the hardness and refractory character of these materials, their thermal conductivities can be surprisingly low with a glass-like temperature dependence. These features are manifestations of the distinctive structure and bonding of these solids. In fact, this novel mix of properties makes the boron carbides exceptionally good very-high-temperature p-type thermoelectric materials. Icosahedral boron-rich solids have additional potential as high temperature semiconductors. In particular, the wide-gap icosahedral boron-rich pnictides, B/sub 12/P/sub 2/ and B/sub 12/As/sub 2/, may be doped to form wide-gap refractory semiconductors. For example, replacement of the group V element with either a group VI or a group IV element is expected to yield n-type and p-type materials, respectively.

15382 **Thermal conductivity of boron carbides.** Moss, M. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The thermal conductivity, k, of boron carbides of various B/C ratios, two modes of preparation -- hot pressed and carbothermic, and two isotopic variants of boron -- /sup 11/B and normal boron /sup 10.81/B, was measured from 300 to 1023 K. The density and composition of the samples were reflected in the magnitude and temperature dependence of k, and were investigated further with scanning electron microscopy, Rutherford backscattering spectroscopy, and Raman spectroscopy. While lower than theoretical density in B/sub 4/C reduces k, the characteristic monotonic decline of k with increasing temperature is retained. This k-vs.-T behavior distinguishes B/sub 4/C from material with larger B/C ratios for which the temperature dependence is essentially nil.

15383 **Microscopic origin of the composition-dependent change of the thermal conductivity in boron carbides.** Emin, D.; Howard, I.A.; Green, T.A.; Beckel, C.L. (Sandia National Labs., Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

Large grain polycrystalline boron carbides have a high-temperature thermal conductivity which changes from being characteristic of a crystal to being glass-like as the carbon content is reduced from its maximal value. We relate this phenomenon, to compositional changes within the three-atom intericosahedral chains. With a reduction of the carbon concentration from its maximal concentration (20%), a carbon atom within some of the three-atoms (CBC) intericosahedral chains is replaced by a boron atom, thereby producing CBB chains. We estimate that the CBB chains are significantly softer than the CBC chains. Thus, with this reduction of carbon content the intericosahedral chains are inhomogeneously softened. This suppresses the coherent transport of heat through the chains. The remaining thermal transport occurs incoherently through vibrationally inequivalent structural units, i.e. "phonon hopping."

15384 **A theoretical approach to the thermal conductivity of boron carbides.** Kenkre, V.M.; Fan, X. (Dept. of Physics and Astronomy, Univ. of New Mexico, Albuquerque, NM (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The thermal conductivity of boron carbides at high temperatures presents a fundamental challenge to theory. One of the striking features is that, while in B/sub 4/C it displays "normal" behaviour in that it decreases with increasing temperature, in B/sub 9/C it is nearly temperature-independent. The author addresses this feature through a model calculation which assumes the heat current to be due to carrier phonons whose frequency is modulated by lower-frequency phonons which "dress" the carrier phonons through strong interaction. Preliminary calculations show satisfactory but partial agreement with experiment for reasonable parameters and delineate areas for further investigation of the vibrational properties of boron carbides.

15385 **Fundamental developments in ultrasonics for advanced NDC.** Bhardwaj, M.C. (Ultran Labs., Inc., State College, PA (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

Although ultrasound has been in use for overt flaw detection in the metals industry for a long time, only in recent years has it attracted the attention of materials scientists for property and micro-structure evaluations. The lack of adequate and reliable ultrasonic hardware has seriously handicapped experimental work. This has led to the materials community's justifiable distrust of using ultrasound for NonDestructive Characterization (NDC). Now that the knowledge required for the creation of suitable ultrasonic hardware and techniques for using it have also been developed, predictably there will be major advances in ultrasonic NDC. This paper describes the importance of characterization and presents a perspective of the ultrasonic characterization of materials. Also depicted are major fundamental and practical developments in ultrasonic technology from Ultran Laboratories. Ranging in frequency from <100KHz to >100MHz, novel techniques such as "dry (self) coupling," "Lambda," and "geometrical acoustics," are applied to a wide range of materials. Advancements in time domain and spectroscopical methods are suggested for the evaluation of materials property, texture, surface defects, bulk defects, and other potential failure-causing mechanisms in materials.

15386 **An evaluation of nondestructive methods for ceramic heat exchanger applications.** Bower, J.R.; Powers, T. (Babcock and Wilcox Co., Lynchburg Research Center, Lynchburg, VA (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

This report covers the first phase of a larger program, whose object is to assure energy efficient design lifetimes of high temperature structural ceramics. This requires acceptance criteria against which the components can be tested. These criteria must be based on both knowledge of which defects can be detected through nondestructive methods and a fracture mechanics analysis of the effects of various flaws. This first phase of the project included the fabrication, inspection and mechanical testing of a range of material conditions that can limit strength and service lifetime. There was an evaluation of several material inspection technologies that were specifically developed to evaluate material conditions unique in ceramics, where flaw sizes an order of magnitude smaller than in metals can cause failure. Both natural flaws and artificially induced flaws in silicon carbide ceramics were destructively evaluated to establish preliminary strength limiting information and evaluate test methods.

15387 **NDE of advanced structural ceramics.** Simpson, W.A. Jr.; McClung, R.W. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

The excellent high-temperature thermal, mechanical, and physical properties of structural ceramics make them likely choices for use in advanced engine designs, enabling higher combustion temperatures and therefore higher thermodynamic efficiencies to be realized. However, the relatively low fracture toughness, and hence critical flaw size, of structural ceramics precludes the use of standard nondestructive evaluation techniques that have been developed over the last 30 years for detection and characterization of critical flaws in metals. The authors describe the development of techniques for the evaluation of ceramics using high-frequency elastic waves to prove the region of interest. Flaws smaller than 25 μm have been detected in monolithic and composite ceramics at depths of about 3 mm in alumina, silicon carbide and silicon nitride, and about 5 mm in zirconia. Advanced procedures are described for the rapid determination of attenuation as a function of frequency for studies of microstructural variation. Both frequent-dependent and -independent corrections are made automatically to yield the true material attenuation. An example of the detection of whisker clumping in a composite ceramic by variations in the attenuation characteristic is presented.

15388 **Projection microradiography of ceramic turbine components.** Khandelwal, P.K. (Allison Gas Turbine Div., General Motors Corp., Indianapolis, IN (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

Microfocus radiography was utilized to detect defects in structural monolithic ceramic materials and ceramic matrix composites for gas turbine engines. Process induced and simulated flaws were detected in ceramic turbine rotors, blades and backplates. Simulated 20-50 micron pores were detected in thin cross sections of silicon based ceramics. The x-ray thickness and equivalent penetrameter sensitivity for detecting holes and voids in silicon carbide and silicon nitride varies between 0.5% to 1.1%. Natural flaws were detected in a gasifier rotor with a thickness sensitivity of 1.8%.

15389 **Ultrasonic characterization of porosity in advanced SiC ceramic composites.** Walter, J.B.; Lott, L.A.; Gammell, P.M. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

Ceramic-reinforced ceramic-matrix composites are advanced materials currently being developed for high temperature, high strength applications such as heat engine components, heat exchangers, and recuperators. The particular material considered here was a SiC-fiber-reinforced SiC matrix formed by chemical vapor infiltration (CVI). The initial focus was on porosity, which has been linked to the material strength. Ultrasonic attenuation and velocity were investigated since they were expected to be affected by the porosity in the material. The objectives of the study were to determine the capability of conventional methods to measure the ultrasonic properties of the materials, and develop improved methods where necessary; to determine the correlations between ultrasonic properties and material properties of interest; and to demonstrate the ability of the ultrasonic technique to nondestructively characterize ceramic composite components.

15390 **Inspection of advanced ceramics with a conventional film-based tomography system.** Ellingson, W.A.; Hentea, T.; Kriz, R.J. (Materials and Components Technology Div., Argonne National Lab., Argonne, IL (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

It has been known for some time that conventional film-based tomography (analog) systems are useful for inspecting individual sections of complex structures. However, image quality is reduced because of blurring introduced by features above and below the tomographic plane of interest. The authors applied analog tomographic imaging to advanced monolithic ceramic specimens with known defects and completed an initial effort to deblur the resulting images. A Siemens medical Optiplanimat system was used but the film used for the study was industrial film. The focal-spot size of the tungsten X-ray head was nominally 300 μm with a 2.5-mm Al equivalent filtration. The authors used a circular head motion and film with no screens. A defect-seeded Si/sub 3/N/sub 4/ ceramic specimen and a special defect-seeded plastic test specimen were used. The in-plane slice thickness was —1 mm and each section image was obtained in 2.5-4.0 s. The preliminary results suggest that inclusions of the order of 100-200 μm can be detected with such an imaging system and that deblurring will likely be effective.

15391 **The use of NMR imaging to measure porosity and binder distributions in green-state and partially sintered ceramics.** Ackerman, J.L.; Garrido, L.; Ellingson, W.A.; Weyand, J.D. (NMR Facility, Dept. of Radiology, Massachusetts General Hospital, Boston, MA (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

Nonuniformities in porosity or binder distribution in green-state ceramic compacts can lead to failure in the final densified material. NMR imaging is a nondestructive characterization technique, most commonly used in medical diagnosis, which the authors adapted for the production of tomographic images of porosity and of binder distributions. They measure open porosity by the imaging of suitable filler fluid introduced into the part by vaccuum impregnation. The authors' results on partially sintered bodies show rough correlations with predicted porosity distributions. Binders with a high content of plasticizer may be imaged directly. Binder distributions with a plasticizer weight percent typical of those used in cold-pressing and injection molding cannot be imaged with conventional clinical or animal research instrumentation and methods. The authors have been successful in imaging such binders directly, using a standard Oxford Instruments 2.0 Tesla, 18 cm diameter horizontal bore superconducting magnet, a Technicare developmental imager, a special high sensitivity, high magnetic field gradient NMR probe and methods they have developed for the imaging of solid materials. These same methods and instrumentation show promise for the detection of features under 50 micrometers. They present results illustrating our techniques in a series of green-state and partially sintered aluminas.

15392 **Needs assessment for NDT and characterization of ceramics.** McClung, R.W.; Johnson, D.R. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

A needs assessment was performed for nondestructive testing and materials characterization to achieve improved reliability in ceramic materials for heat engine application. Considered were raw materials, green state bodies, and sintered ceramics. This paper discusses applications of nondestructive testing to green state and sintered ceramics. Included are identification of critical characteristics that affect material properties and performance, potential examination techniques, and the results of prior studies of technique applications to ceramic materials.

15393 **Needs assessment for NDT and characterization of ceramics: I. Approach to reliability and assessment of inspection and characterization technology for raw materials.** Johnson, D.R.; Janney, M.A.; McClung, R.W. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

A needs assessment was performed for nondestructive testing and materials characterization to achieve improved reliability in ceramic materials for heat engine application. Considered were raw materials, green-state bodies, and sintered ceramics. This paper discusses the overall approach taken to improve reliability of structural ceramics, which requires key inspections throughout the fabrication flowsheet, including raw materials, green-state bodies, and dense parts. The application of nondestructive inspection and characterization techniques to ceramic powders and other raw materials is discussed. The current state of inspection technology for ceramic raw materials and the priorities for development of new inspection techniques are discussed.

15394 **Materials testing in the 21st century.** McCauley, J.W. (U.S. Army Materials Technology Lab., Materials Characterization Div., Watertown, MA (US));. pp v of Nondestructive testing of high-performance ceramics. Westerville, OK; American Ceramic Society Inc. (1987). (CONF-870856—).

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

In the 21st century, society will require materials with the maximum achievable performance and reliability at the lowest possible cost. High performance ceramic, polymeric and composite materials will have replaced traditional metals in many engineering applications. Exotic surface modification techniques will be in common use. In order to cope with these enormous changes the advanced materials and testing communities must recognize the importance of materials characterization concepts for controlling and monitoring a material's full unique signature of chemical, structural and defect characteristics, compared to traditional reliance on post manufacture flaw interrogation for property assurance. This will require the extension of traditional NDT into chemical and microstructural interrogation, transitioning sophisticated materials characterization techniques out of the research laboratory, establishing material unique signature and property knowledge bases and developing new concepts in sensor technology.

15395 **Interface structure in silicon carbide-silicon nitride composites.** Nutt, S.R.; Phillips, D.S. (Center for Solid State Science, Arizona State Univ., Tempe, AZ (US));. pp v of Interfaces in metal-matrix composites. Dhingra, A.K.; Fishman, S.G. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-860340—).

From 115. American Institute of Mining, Metallurgical and Petroleum Engineers annual meeting; New Orleans, LA, USA (2 Mar 1986).

High resolution TEM techniques have been used to investigate the atomistic structure of interfaces in SiC whisker-reinforced silicon nitride (Si/sub 3/N/sub 4/) consolidated by hot-pressing. SiC whiskers used in composites were grown by a VLS process, and exhibited rounded triangular cross-sections. Examination of composite specimens revealed that the whisker interface plane, ostensibly exhibited microscopic steps and ledges on alternating planes. No evidence of fiber-matrix intercalation was found, although an interfacial glass layer was sometimes present. Glass phase constituents often coalesced at grain boundary-interface junctions and devitrified to form a Mg-sialon phase that was epitaxial on the SiC whisker. Effects of processing temperature on the evolution of interface phases are discussed and related to certain fracture characteristics.

3606 Other Materials

REFER ALSO TO CITATION(S) 14353, 14358, 14533, 14534, 14537, 14541, 14544, 14547, 14591, 14837, 14938, 15120, 15207, 15292, 15518, 15569, 15575, 15580, 15581, 15721, 15914, 16251, 16531, 16553, 16610, 16610, 16610, 16610, 16624, 16653, 16793, 16815

15396 **(AD-A—200613/8/XAB) Investigation of near-surface chemical, physical and mechanical properties of silicon carbide crystals and fibers modified by ion implantation. Final report.** Spitznagel, J.A.; Wood, S. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 17 Aug 1988. 108p. NTIS, PC A06/MF A01.

Modification of chemical, physical and mechanical properties of ceramic/semiconductor surfaces by ion implantation provides an opportunity to define and obtain desirable properties for a variety of applications. These include: interfaces in composite materials, electrical properties of devices and contacts, and specialized surfaces for optical waveguides, wear and corrosion resistance, etc. In this study, single crystals (6H), and whiskers of high-purity silicon carbide were implanted with a variety of n- and p-type dopants (B, N, Al, P), an isovalent dopant (Ti), inert species (Ne) and hydrogen. Isochronal anneals at temperatures up to 1173K permitted systematic evaluation of thermal effects in the implanted region. Implants fluences were normalized to permit comparisons on the

basis of equal concentrations of displaced Si atoms for each ion. Microstructural, mechanical and chemical effects were studied by a series of RBS/channeling, TEM, SEM, microhardness, microtensile, AES, SIMS, and wetting (sputtered and molten metal) measurements. Recovery of crystalline structure during annealing is shown to be relatively independent of the implant species but depends upon the number of atomic displacements in the Si sublattice. Near-surface mechanical and chemical effects, however, are very dependent on the chemical/electrical nature of the implanted ions. Applications to ceramic/metal interfaces in metal matrix composites are discussed.

15397 **(BMFT-FB-T—86-078) Studies on the progress of carbonation of concrete with and without pulverised-fuel ash. Final report.** Lehmann, H. (Wasser- und Schiffahrtsdirektion West, Muenster (Germany, F.R.). Baustoffpruefstelle; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1986. 59p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88756621/JAW.

The influence of a concrete mix and of curing on carbonation is known from former research. Fly ash has been used as additive in concrete since 1960. Its effect on the progress of carbonation was therefore only recently subject of investigation. The first buildings with addition of fly ash to concretes have meanwhile been exposed to the influence of the weather a long time, so that the idea of measuring the carbonation of such buildings was obvious. By laboratory tests of concrete mixes with and without fly ash additional information on the influence of fly ash on carbonation ought to be gained. From the investigation of concrete in buildings resulted no significant difference of carbonation owing to fly ash. The laboratory test measurements are to be continued some time, for it needs a long observation time to get positive results from these tests. (orig./EF) With 13 refs., 12 tabs., 21 figs.

15398 **(BNL—42141) Slow component suppression and radiation damage in doped BaF_2 crystals.** Woody, C.L.; Levy, P.W.; Kierstead, J.A. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-881103—31). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006179/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

The scintillation and radiation damage properties of barium fluoride crystals doped with various rare earths have been studied in an attempt to develop a fast, radiation hard scintillating crystal with a suppressed slow component for use at high counting rates. The light output of doped BaF_2 samples was measured with a solar blind (CsTe) photomultiplier tube and compared with a standard bialkali phototube. For dopants showing strong slow component suppression, measurements were also made at elevated temperatures and indicate that additional suppression can be achieved by heating. Radiation damage was studied by measuring the light transmission before, during and after irradiation with ^{60}Co gamma rays for doses greater than 10^6 rad. The results show that several dopants suppress the slow component, but only one, namely lanthanum, preserves the radiation hardness of undoped BaF_2. 22 refs., 9 figs., 1 tab.

15399 **(BNL—42170) Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte: 2. Polymer mixtures.** Le, Tien; Linkous, C.A. (Brookhaven National Lab., Upton, NY (USA)). Oct 1988. Contract AC02-76CH00016. 46p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006980/JAW.

The thermal stability of 17 candidate polymeric materials were tested for weight-loss under a steam atmosphere. A number of polymers which were stable under steam treatment were also tested under N_2 atmosphere. The following 13 polymers stable in steam atmosphere for 4 hours or more showed promise for use as a solid polymer electrolyte: polybenzimidazole (PBI), phosphate PBI, polyimide, Teflon, polyamide resin, poly(phenylene sulfide), Nafion, poly(ethylene oxide), poly(acrylonitrile), poly(vinylpyrrolidone), poly(ethylene glycol), and poly(2-vinylpyridine). Four stable polymers at 300-400{degree}C and six stable polymers at 200{degree} in steam atmosphere were crossed with each other by blending or compressing methods. Mixtures involving poly(vinylpyrrolidone) gave a protective effect, i.e., the onset temperature of decomposition of the vinylpyrrolidone was increased by incorporation into a high temperature polymer matrix. 10 refs., 27 figs., 4 tabs.

15400 **(CEA-tr—2289) Influence of irradiation on electrical properties of polyimide impregnated insulating materials.** Borisova, M.E.; Koikov, S.N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1988. 6p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756436/JAW.

Aging by both gamma radiations and electrical field of glass fibers impregnated with polyimide LSN-180 used as insulating material for coils of the Tokamak T-15 is examined in this paper.

15401 **(CONF-880312—2) Measurements of the compressive behavior of AS4/3501-6 and IM7/8551-7 carbon/epoxy.** Swanson, S.R.; Colvin, G.E. Jr.; Haslam, C.L. (Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering; Hercules Aerospace Corp., Magna, UT (USA). Bacchus Works). 1988. Contract W-7405-ENG-48. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005823/JAW.

From 33. symposium and exhibit on materials and processes for all industries: materials - pathway to the future; Anaheim, CA, USA (7 Mar 1988).

The compressive strength of carbon/epoxy materials is of importance in design, and is typically somewhat lower than the strength in tension. The measurement of compressive strength has been subject to some uncertainty, as different experimental techniques can give somewhat different results. A new specimen for the determination of compressive strength has been developed, based on compression of a 38 mm (1.5 in) diameter tube. The tube has been designed to prevent overall structural buckling and also to minimize end effects. This and a larger tubular specimen have been utilized to determine the compressive strength of AS4/3501-6 and IM7/8551-7 carbon/epoxy prepregs. The results are compared with previous tests, indicating that the results are relatively independent of the test specimen. The comparison also supports a criterion for laminate failure prediction reported previously. 15 refs., 6 figs., 1 tab.

15402 **(CONF-880901—16) Irradiation as a tool for studying solid state amorphization phenomena.** Pedraza, D.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006034/JAW.

From Metallurgical Society fall meeting and American Society for Metals materials week; Chicago, IL, USA (24 Sep 1988).

An overview of selected experimental results on amorphization induced by irradiation and by ion implantation is first presented. This overview and other general observations on the microstructural evolution that precedes the transition to the amorphous state of irradiated crystalline materials expose some of the important data that must be accounted for by theory. A perspective of our present understanding of irradiation-induced amorphization is then presented. As described in previous work, the theory assumes a localized buildup of complexes (coupled interstitial/vacancy pairs) to a critical value as the mechanism of amorphization. The theory of complex formation implies that the production of a defective state characterized by localized anisotropic distortions of the crystalline lattice leads to amorphization. It is proposed that this concept can be generalized to encompass solid state amorphization transitions other than those induced by irradiation. Examples available in the literature to support this idea are presented. It is therefore suggested that irradiation can be used as a valuable tool to study other solid state amorphization transitions. 47 refs., 3 figs.

15403 **(CONF-881155—42) Damage formation in semiconductors during MeV ion implantation.** Sjoreen, T.P.; Holland, O.W.; El-Ghor, M.K.; White, C.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006414/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Damage produced by 1.0--2.5 MeV self-ion and O-ion implantation into Si and Ge single crystals has been characterized by

cross-sectional electron microscopy and ion channeling. In Si, it is observed that the damage morphology varies substantially along the ion's track. Near the end-of-range of the ion, damage accumulation is very similar to that which occurs during medium- to low-energy implantation (i.e., damage increases monotonically with dose until the lattice is made completely amorphous). In front of this end-of-range region, however, damage saturates at a very low level for moderate implantation fluences. A model based on homogeneous damage nucleation in Si is discussed. For Ge, damage accumulation is very different; a monotonic increase of damage with dose is observed over the entire range of the ion. Possible mechanisms responsible for the differences between Si and Ge are discussed. 11 refs., 4 figs., 1 tab.

15404 **(CONF-890142—2) Hardness of amorphous hard carbon films determined by the ultra-low load microindentation technique.** Joslin, D.L.; O'Hern, M.E.; McHargue, C.J.; Clausing, R.E.; Oliver, W.C. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006129/JAW.

From Symposium on lasers and optics; Los Angeles, CA, USA (15 Jan 1989).

Amorphous carbon films variously designated as i-C, α-C:H, diamond-like or hard carbon films, have interesting optical and mechanical properties and are candidates for wear and corrosion protection in a wide range of applications. Because the depth of penetration by the indenter in normal hardness tests often approaches or exceeds the thickness of the diamond-like coating film, hardness data may reflect large substrate effects. This paper gives the results of ultra-low load microindentation hardness measurements which allow data to be obtained for indentation depths as small as 20 nm. The data also yield information on the elastic modulus of the coatings. Films were obtained from a number of sources and had been prepared by several techniques. The hardness values are in the range of 7 to 15 GPa and depend on the exact preparation parameters. The hardness data will be compared to those obtained by the Knoop technique. 6 refs., 10 figs.

15405 **(CONF-890145—7) Fabrication of XLWIR [extra-long-wavelength-infrared] window materials.** Kim, Hyoun-Ee; Moorhead, A.J. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006418/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

A technique was developed for fabrication of strong, fully dense, polycrystalline windows of CsI by hot-pressing in a steel die. We began with ultra-pure, ultra-dry CsI powder and conducted all processing operations within a glove box purged with dry N_2. We were able to hot-press 5.08 cm CsI discs having transmittance of about 80% in the extra long wavelength ({greater than or equal to}10 μm) infrared range---equivalent to that of single crystal CsI. The flexural strength of CsI bars fabricated by hot pressing small-particle-size powder was 18 MPa, about 5 times higher than that of single crystal CsI. 7 refs., 9 figs.

15406 **(DOE/ER/45205—4) Softening mechanisms and microstructural instabilities during high temperature low cycle fatigue of Ni, Ni_3Al and their metal matrix composites: Progress report, June 1, 1988--May 31, 1989.** Gottstein, G. (Michigan State Univ., East Lansing (USA)). Jan 1989. Contract FG02-85ER45205. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007117/JAW.

The microstructural development and mechanical behavior associated with high temperature low cycle fatigue were investigated and modeled. Fatigue crack growth during high temperature low cycle fatigue was accompanied by dynamic recrystallization, but dynamic recrystallization did not interfere with the propagation of cracks along cavitated boundaries. The occurrence of dynamic recrystallization in Ni_3Al was evidenced by high temperature compression tests. Preliminary results of computer simulation of high temperature cyclic deformation indicate that the extensive microstructural changes during high temperature low cycle fatigue can be successfully modeled by SIBM and orientation dependent grain boundary sliding. The recrystallization texture development in Ni_3Al is governed by fast growing orientations with 25{degree}<100> orientation relationship between growing and consumed grains. MMCs with $Ni_3Al(B)$ matrix and Al_2O_3 continuous fiber reinforcement have been successfully produced by vacuum hot pressing. Together with Siemens/Nicolet a fully automatic orientation mapping system with synchrotron radiation has been assembled and will be tested in April 1989.

15407 **(DOE/ER/45236—T1) Studies of melting, crystallization, and commensurate-incommensurate transitions in two dimensions: Third year progress report.** Mockler, R.C.; O'Sullivan, W.J. (Colorado Univ., Boulder (USA). Dept. of Physics). Sep 1988. Contract FG02-86ER45236. 87p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005907/JAW.

The free expansion melting of a 2D suspension of micron-size polystyrene spheres contained between parallel silica plates has been analyzed in some detail. The translational and orientational correlation functions conform with KTHNY theory prediction of a two-step melting process. The visual observations and study of the defect structures and evolution strongly suggest the process is first order with two-phase coexistence taking the place of the intermediate (hexatic) phase. On the other hand, melting of a 2.88 μm monolayer on water is in accord with KTHNY including the observation of dislocation-pair unbinding at the first transition. However, there is no evidence of the dissociation of dislocation into free disclinations at the second transition (the defect structure is much too complex here). Dynamic light scattering experiments on a 2D crystal on the surface of water yield viscous damping factors, force constants and the Lame coefficients. 2D computer simulation, reveal cooperative motion along chains of particles ("snakes"). They appear to be the principal cause of diffusion near the melting point and important in the melting process. 36 refs., 17 figs.

15408 **(DOE/ER/45368—1) Multicomponent glass surfaces structure and adsorption: Progress report, August 1, 1988--December 31, 1988.** Garofalini, S.H. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Ceramics). 1988. Contract FG05-88ER45368. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006904/JAW.

In this research program, we will study the surface structure of multicomponent silicate glasses and the effect of that structure on adsorption behavior. The effect of cation additives in silica glass on surface properties such as bond lengths, defect types, and ring structures will be evaluated. The resultant effect of these surface features on adsorption behavior will also be evaluated. Both theoretical and experimental techniques will be used. The theoretical aspect will involve molecular dynamics computer simulations and the experimental aspect will involve surface analysis techniques. The substrate glasses will include silicates containing alkali ions and multivalent ions such as Al, Ca, etc. The adsorbates will include a strongly interacting adsorbate, such as Pt, and a weakly interacting one, such as Au.

15409 **(INIS-BR—1402) Superficial deformations determination in silicon monocrystals by X-ray difraction.** Carvalho, C.A.M. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1985. 120p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705515/JAW.

We present a technique of determination of deformation distribution in monocrystal surfaces through the adjustement of Bragg reflection patterns obtained from the X-ray diffraction theory. (M.W.O.).

15410 (INIS-mf—11348, pp 105) **Optically transparent organometallic copolymer for shielding ionizing radiation. Part I.** Dabek, R.; Garcia Braham, R. (Universidad Autonoma de Coahuila (Mexico). Facultad de Ciencias Quimicas). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15411 (INIS-mf—11348, pp 107) **Mass attenuation coefficients of mixtures of cement, iron and sand. Its use as shielding.** Lugo R, J.F. (Universidad Autonoma de Zacatecas (Mexico), Centro Regional de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15412 **(LA—11457-MS) Water-in-oil emulsions and toroidal microstructures.** Williams, J.M. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 119p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006779/JAW.

Polymerization of emulsions made from styrene-divinylbenzene-dodecane-water mixtures provides a useful route to open-microcellular rigid foams. The structures of the resulting foams demonstrate that the emulsions possess considerable segregation and alignment of each molecular species at the time of polymerization. Simple pictorial models are sufficient to explain the emulsion structures and the resulting foams. Toroidal microstructures are predicted and observed. 74 refs., 12 figs.

15413 **(LBL—25625) The morphological development of the Nb_3Sn phase in multifilamentary superconducting wire.** Dietderich, D.R. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 141p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007128/JAW.

Multifilamentary superconducting wire is used to produce high magnetic fields. One of the materials utilized is Nb_3Sn produced by "bronze-type" processes. To achieve peak properties the wire fabrication technique and the Nb_3Sn grain morphology and composition must be optimized. This work investigated the variation in critical current of an internal-tin-processed wire and a bronze-processed wire to determine the source of the superior properties in the internal tin wire. 74 refs., 4 tabs.

15414 **(LBL—26285) A study of the structure and composition of an iron silicate catalyst, FeZSM-5, via electron microscopy.** Csencsits, R. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 77p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006648/JAW.

The purpose of this research is to understand the structural and compositional changes of an iron silicate catalyst as a function of preparation and processing conditions. The relationship between synthesis conditions and the inter-particle and intra-particle compositional variations are determined; structural changes resulting from thermal and hydrothermal treatments are studied. Emphasis is placed on understanding the relationships between processing, structure, catalytic activity and selectivity. 51 refs., 32 figs, 4 tabs.

15415 **(LBL—26337) Thermal oxidation of III-V compound semiconductors.** Neto, O.R.M. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 105p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007127/JAW.

Thermal oxidation of III-V compound semiconductors has been studied in the temperature range of 300{degree}C to 600{degree}C. Two members of this class of materials, namely InP and GaAs, were the object of the experimental work carried out here. The main analytical tools used were transmission electron microscopy (TEM) and secondary ion mass spectroscopy (SIMS). TEM was employed to access microstructural changes and SIMS to access the composition redistribution that takes place as a consequence of the oxidation reaction. Below 400{degree}C oxidation of both materials led to the formation of amorphous scales, which consisted of a mixture of gallium and arsenic oxides in the case of GaAs, and indium phosphate and oxide in the case of InP. The oxidation kinetics of InP was found to be slower than that of GaAs. In the high temperature regime, i.e., above 400{degree}C, the oxidation of both materials resulted in crystalline products. Precipitation of the group V element at the scale/semiconductor interface took place during oxidation. At the GaAs/Ga_2O_3interface, As precipitates were formed with a truncated square pyramid shape bound by {l←brace}111{r←brace}/sub GaAs/ planes. The precipitates found at the $InPO_4$/InP interface were either a phosphorus rich phase or red phosphorus. Strong vaporization under the electron beam prohibited a more accurate determination. The morphology of those precipitates were very similar to the As ones in GaAs. 83 refs., 48 figs., 6 tabs.

15416 (N—89-12582, pp 51-65) **NASA atomic oxygen effects test program.** Banks, B.A.; Rutledge, S.K.; Brady, J.A. 1988. NTIS, PC A21/MF A01. (NASA-CP—3015; REPT—88B0253; NAS—1.55:3015; CONF-8810291—).

From 15. space simulation conference: support the highway to space through testing; Williamsburg, VA, USA (31 Oct 1988).

The NASA Atomic Oxygen Effects Test Program was established to compare the low earth orbital simulation characteristics of existing atomic oxygen test facilities and utilize the collective data from a multitude of simulation facilities to promote understanding of mechanisms and erosion yield dependence upon energy, flux, metastables, charge, and environmental species. Four materials chosen for this evaluation include Kapton HN polyimide, FEP Teflon, polyethylene, and graphite single crystals. The conditions and results of atomic oxygen exposure of these materials is reported by the participating organizations and then assembled to identify degrees of dependency of erosion yields that may not be observable from any single atomic oxygen low earth orbital simulation facility. To date, the program includes 30 test facilities. Characteristics of the participating test facilities and results to date are reported.

15417 (N—89-12582, pp 66-88) **Materials selection for long life in LEO: a critical evaluation of atomic oxygen testing with thermal atom systems.** Koontz, S.L.; Kuminecz, J.; Leger, L.; Nordine, P. 1988. NTIS, PC A21/MF A01. (NASA-CP—3015; REPT—88B0253; NAS—1.55:3015; CONF-8810291—).

From 15. space simulation conference: support the highway to space through testing; Williamsburg, VA, USA (31 Oct 1988).

The use of thermal atom test methods as a materials selection and screening technique for low-Earth orbit (LEO) spacecraft is critically evaluated. The chemistry and physics of thermal atom environments are compared with the LEO environment. The relative reactivities of a number of materials determined to be in thermal atom environments are compared to those observed in LEO and in high quality LEO simulations. Reaction efficiencies measured in a new type of thermal atom apparatus are one-hundredth to one-thousandth those observed in LEO, and many materials showing nearly identical reactivities in LEO show relative reactivities differing by as much as a factor of 8 in thermal atom systems. A simple phenomenological kinetic model for the reaction of oxygen atoms with organic materials can be used to explain the differences in reactivity in different environments. Certain specific thermal test environments can be used as reliable materials screening tools. Using thermal atom methods to predict material lifetime in LEO requires direct calibration of the method against LEO data or high quality simulation data for each material.

15418 (N—89-12582, pp 89-109) **Atomic oxygen studies on polymers.** Morison, W.D.; Tennyson, R.C.; French, J.B.; Braithwaite, T.; Moisan, M.; Hubert, J. (Montreal Univ., Quebec (Canada)). 1988. NTIS, PC A21/MF A01. (NASA-CP—3015; REPT—88B0253; NAS—1.55:3015; CONF-8810291—).

From 15. space simulation conference: support the highway to space through testing; Williamsburg, VA, USA (31 Oct 1988).

The purpose was to study the effects of atomic oxygen on the erosion of polymer based materials. The development of an atomic oxygen neutral beam facility using a SURFATRON surface wave launcher that can produce beam energies between 2 and 3 eV at flux levels as high as approx. 10 to the 17th power atoms/cm (2)-sec is described. Thin film dielectric materials were studied to determine recession rates and and reaction efficiencies as a function of incident beam energy and fluence. Accelerated testing was also accomplished and the values of reaction efficiency compared to available space flight data. Electron microscope photomicrographs of the samples' surface morphology were compared to flight test specimens.

15419 **(SAND—88-3154C) Fractals and phase separation.** Schaefer, D.W.; Bunker, B.C.; Wilcoxon, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 33p. (CONF-8810287—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005596/JAW.

From Royal Society discussion meeting on fractals in the natural sciences; London, UK (19 Oct 1988).

Fractal patterns are typically observed in systems that develop far from equilibrium. Since phase separating systems are far from equilibrium following a quench, we searched for fractal correlations in two quenched systems: borosilicate glasses and micellar solutions. Because scattering techniques are used, we review the expected scattering profiles expected for spinodal decomposition, nucleation and growth, and kinetic aggregation. In the borosilicate glasses, no non-classical structures are observed unless the boron-rich phase is leached out. Upon leaching, a peak appears in the scattering profile and, depending on leaching conditions, surface fractal porosity develops. We trace the observed structure to the leach process itself, which we believe produces phase separation by nucleation and growth. Short range structure is explained in terms of reaction-limited dissolution. In micelle solutions, we find fractal patterns following a quench along the critical isochore into the unstable regime. A quench of equivalent depth off the critical isochore into the metastable regime produces no unusual structures. Fractal scattering profiles are also observed in the single phase regime near the critical point. These observations suggest growth of polymeric structures in the single phase regime. 23 refs., 14 figs.

15420 **(STEV-FJV—88-1) Development of a quick evaluation method for judging the life-time of plastic pipes for hot-water flow. Stage 1.** Ifwarson, M. (Studsvik Energy, Nykoeping (SE)). (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). 16 May 1988. 27p. (In Swedish). (STUDSVIK-EX—88-30). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756296/JAW.

The project has covered pressure testing of plastic pipes at 110 deg. C in three different atmospheres, namely 21% oxygen, 60% oxygen and 100% oxygen. 24 samples have been tested with the longest duration of 14500h. One of the species displayed an apparent correlation of life-time and oxygen concentration on the outside of the pipe. (G.B.).

15421 **(UCID—18756-Rev.3) User's manual for DYNA2D: An explicit two-dimensional hydrodynamic finite element code with interactive rezoning and graphical display.** Hallquist, J.O. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 147p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006695/JAW.

This revised report provides an updated user's manual for DYNA2D, a vectorized, explicit, two-dimensional, axisymmetric and plane strain finite element code for analyzing the large deformation dynamics and hydrodynamic response of inelastic solids. A contact-impact algorithm permits gaps and sliding with friction along material interfaces. By a specialization of this algorithm, such interfaces can be rigidly tied to admit variable zoning without the need of transition regions. Spatial discretization is achieved by the use of 4-node solid element, and the equations-of-motion are integrated by the central difference method. An interactive rezoner eliminated the need to terminate the calculation when the mesh becomes too distorted. Rather, the mesh can be rezoned and the calculation continued. The command structure for the rezoner is described and illustrated by an example. 32 refs., 23 figs., 2 tabs.

15422 **(X-EP-LPICM-RA—1986) Annual report of the Interface and Thin Film Physics Laboratory, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 12p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756711/JAW.

Research on amorphous semiconductors (optimization of radio frequency plasma deposition, analysis of free radical composition in hydrate plasmas, photochemical deposition of amorphous silicon, silicon-germanium alloys with good electron transport properties); characterization of layers and interfaces; and product development (solar cells, charged particle detectors) is presented.

15423 **Nucleation mechanisms and the elimination of misfit dislocations at mismatched interfaces by reduction in growth area.** Fitzgerald, E.A.; Watson, G.P.; Proano, R.E.; Ast, D.G.; Kirchner, P.D.; Pettit, G.D.; Woodall, J.M. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* **65**: No. 6, 2220-2237(15 Mar 1989).

To investigate the effect of growth area on interface dislocation density in strained-layer epitaxy, we have fabricated 2-μm-high mesas of varying lateral dimensions and geometry in (001) GaAs substrates with dislocation densities of 1.5 x 10^5, 10^4, and 10^2 cm^{-2}. 3500-, 7000-, and 8250-A-thick In/sub 0.05/Ga/sub 0.95/As layers, corresponding to 5, 10, and 11 times the experimental critical layer thickness as measured for large-area samples, were then deposited by molecular-beam epitaxy. For the 3500-A layers, the linear interface dislocation density, defined as the inverse of the average dislocation spacing, was reduced from greater than 5000 to less than 800 cm^{-1} for mesas as large as 100 μm. A pronounced difference in the linear interface dislocation densities along the two interface <110> directions indicates that α dislocations nucleate about twice as much as β dislocations. For samples grown on the highest dislocation density substrates, the linear interface-dislocation density was found to vary linearly with mesa width and to extrapolate to a zero linear interface-dislocation density for a mesa width of zero. This behavior excludes dislocation multiplication or the nucleation of surface half-loops as operative nucleation sources for misfit dislocations in these layers. Only nucleation sources that scale with area (termed fixed sources) are active. In specimens with lower substrate dislocation densities, the density of interface dislocations still varies linearly with mesa size, but the slope becomes independent of substrate dislocation density, indicating that surface inhomogeneities now act as the dominant source for misfit dislocations.

15424 **Macromolecular character of amber.** Wert, C.A.; Weller, M.; Schlee, D.; Ledbetter, H. (Materials Research Laboratory and Department of Materials Science and Engineering, University of Illinois, 1304 West Green Street, Urbana, Illinois 61801). *Journal of Applied Physics;* **65**: No. 6, 2493-2499(15 Mar 1989).

Measurements are reported of anelastic and dielectric loss of various ambers and copals. They show spectra typical of synthetic polymers. This similarity permits description of the macromolecular character of amber which was not possible from previous studies of chemical composition. Measurements on amber of several origins and geological ages show generally similar character, but also differences in detail. These may be caused by differences in chemistry of the original resin and the geological age and history of the amber, reflecting differences in degree of polymerization. Also reported are elastic constants measured at high frequency.

15425 **Titanium and carbon coimplantation into sintered α-SiC and hot-pressed Si_3N_4.** Bhattacharya, R.S.; Rai, A.K.; Williams, J.M. (Universal Energy Systems, Inc., 4401 Dayton-Xenia Road, Dayton, Ohio 45432). *Journal of Applied Physics;* **65**: No. 5, 1885-1887(1 Mar 1989).

Sintered α-SiC and hot-pressed Si_3N_4 were coimplanted with 175 keV Ti^+ and 46 keV C^+ at doses of 1 x 10^{17} cm^{-2}. Energies of Ti^+ and C^+ were such that the depth distributions match closely. The samples were annealed at 1200 °C for 2 h in flowing Ar. The samples were characterized by Rutherford backscattering and cross-section transmission electron microscopy. The distribution of Ti in α-SiC remained unaltered after the anneal whereas significant redistribution occurred in Si_3N_4. Cross-section transmission electron microscopy revealed the formation of TiC precipitates in the recrystallized surface layer of SiC. Although some precipitates were found to be present in the recrystallized surface layer of Si_3N_4, the diffraction analysis revealed that these are not TiC.

15426 **Fermi-level movement at metal/HgCdTe contacts formed at low temperature.** Carey, G.P.; Wahi, A.K.; Friedman, D.J.; McCants, C.E.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 7: No. 2, 483-488(Mar 1989).

In an effort to reduce the disruption to the HgCdTe surface upon metal overlayer formation over that observed at room temperature, interfaces formed at 100 K between HgCdTe and the three overlayer metals, Ag, Al, and Pd, are investigated. The metals were deposited onto the [110] cleaved HgCdTe surfaces in UHV in increments ranging from submonolayer at low coverages to tens of monolayers at high coverages, and the formation of the interfaces were monitored using photoemission spectroscopy subsequent to each deposition. The primary experimental observation of this study is that deposition of all three of these metals onto HgCdTe substrates held at reduced temperatures causes the surface Fermi level (E/sub f/) to move from its initial cleaved position, typically located at or near the conduction-band minimum, into the conduction band, and this movement is correlated with the absence of the movement of the overlayer metal into the semiconductor. This phenomenon is observed at the lowest coverages (submonolayer) for all three overlayer metals, and for the case of Ag grown at 100 K, is observed for higher coverages as well. The final positions of E/sub f/ for the three overlayer growths match very closely to those seen for the corresponding room-temperature growths.

15427 **CdTe and ZnTe metal interface formation and Fermi-level pinning.** Wahi, A.K.; Carey, G.P.; Chiang, T.T.; Lindau, I.; Spicer, W.E. (Stanford Electronics Laboratory, Stanford University, Stanford, California 94305). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 2, 494-498(Mar 1989).

Interfacial morphology and Fermi-level pinning behavior at the interfaces of Al, Ag, and Pt with UHV-cleaved CdTe and ZnTe have been studied using x-ray photoelectron and ultraviolet photoemission spectroscopies. Results are compared to metal/HgCdTe interface formation, where the weak Hg—Te bond and consequent ease of Hg loss strongly influence semiconductor disruption and metal—semiconductor intermixing. For Al/CdTe, we observe a case where the strong Al—Te reaction yields a significantly more extensive Al—Te reacted region than has been observed for HgCdTe. The Al/ZnTe interface is observed to be more abrupt than Al/CdTe. The final Fermi-level pinning positions E/sub fi/ = E/sub f/-E/sub vbm/ for Al, Ag, and Pt on p-type CdTe and p-ZnTe have been determined. E/sub fi/ is found to be roughly the same for both CdTe and ZnTe, with the value for ZnTe lying ~0.2 eV closer to the valence-band maximum for all three metals. From these results, one would expect Schottky barriers of about the same height for these metals on p-CdTe and p-ZnTe; and also that, in principle, metal interfaces with the two alloys HgCdTe and HgZnTe would have the same properties. Comparisons and implications for electrical behavior of metal contacts to the alloys are discussed.

15428 **New mechanism for diffusion of ion-implanted boron in Si at high concentration.** Holland, O.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6057). *Applied Physics Letters;* **54**: No. 9, 798-800(27 Feb 1989).

Modeling of the diffusion of high-concentration implanted B in Si is done. The normally accepted model, which assumes that diffusivity of boron is controlled by the singly charged donor vacancy, is shown to be inadequate in describing the boron profiles. Rather, a two-stream model, in which boron movement is dominated by a dissociative process involving both interstitial and substitutional diffusion, is found to be in good agreement with the data.

15429 **Elucidation of x-ray diffraction data on the nature of the ordering of $GaInP_2$ and how the ordering relates to changes in the optical properties.** Kurtz, S.R.; Olson, J.M.; Kibbler, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **54**: No. 8, 718-720(20 Feb 1989).

The relationship between anomalous changes in the band gap and ordering of the group III sublattice of $GaInP_2$ is discussed. X-ray diffraction data are reported for the first time which show significant long-range order of the CuPt type, i.e., alternating {111} Ga and In planes, in agreement with published electron diffraction data. However, the x-ray and electron diffraction data differ as to which of the four possible orientations are observed and as to the directions of the streaks. No correlation was observed between the long-range order parameter and the band-gap anomalies.

15430 **Structural phase stability in lithium to ultrahigh pressures.** Boettger, J.C.; Albers, R.C. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3010-3014(15 Feb 1989).

The relative phase stabilities of the fcc, bcc, and hcp structures for Li are studied up to a compression of 100 by the linear muffin-tin-orbitals method. We make the first theoretical study of phase stability for Li that includes the hcp phase above 350 kbar and find a new high-pressure hcp phase to be stable between 5.4 and 26 Mbar. This phase results from a 2s-to-2p electronic transition that induces a series of phase transitions (fcc→hcp→bcc) in the ultrahigh-pressure range of $5.4<P<26$ Mbar. Above 26 Mbar, the relatively open bcc structure remains the most stable phase up to the highest pressures that were examined (1000 Mbar). At low pressures, the two close-packed structures (fcc and hcp) are found to be favored over the bcc structure, which contradicts a recent calculation showing bcc stability at zero pressure.

15431 **Theoretical phase stability of incommensurable spin structures on the {001} surfaces of MnO-type antiferromagnetic semiconductors.** Chrzan, D.C.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3159-3167(15 Feb 1989).

A theory for the phase stability of incommensurable spin structures on the {001} surfaces of the rock-salt—structure antiferromagnetic semiconductors is presented. The theory is based on classical spins and a simple Heisenberg Hamiltonian dependent on three exchange interactions: (a) a surface-only nearest-neighbor exchange; (b) a surface second-layer nearest-neighbor exchange; and (c) an antiferromagnetic second-nearest-neighbor superexchange throughout the crystal. Incommensurable magnetic surface structures are proven to be the ground state for a considerable range of the surface exchange parameters. The properties of the "frozen" spin waves used in the variational calculation are fully explored, and the implications for low-energy electron diffraction studies of the rock-salt—structure antiferromagnets are discussed.

15432 **Optical transitions involving unconfined energy states in In/sub x/Ga/sub 1-//sub x/As/GaAs multiple quantum wells.** Ji, G.; Dobbelaere, W.; Huang, D.; Morkoc, H. (Coordinated Science Laboratory, University of Illinois at Urbana-Champaign, 1101 West Springfield Avenue, Urbana, Illinois 61801-3082). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3216-3222(15 Feb 1989).

Optical transitions with energies higher than that of the GaAs band gap in highly strained In/sub x/Ga/sub 1-//sub x/As/GaAs multiple—quantum-well structures have been observed in photoreflectance spectra. In some samples as many as seven such structures were present. We identify them as transitions between the unconfined electron states and the confined heavy-hole states. For energies below the GaAs signal, intense transitions corresponding to such unconfined electron subbands were also observed. The intensity of the transitions involving unconfined electron subbands decreases with increasing well width, but is weakly dependent on the mole fraction x. The transmission coefficients are calculated in order to locate the positions of the unconfined electron subband energies. Good agreement is obtained between the experimental data and the theoretical calculation.

15433 **Core-level photoemission studies of the α-Sn/InSb(100) heterostructure system.** John, P.; Miller, T.; Chiang, T. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3223-3229(15 Feb 1989).

Layers of gray tin (α-Sn) were grown epitaxially on InSb(100) substrates at room temperature. The two high-quality InSb(100) reconstructions, Sb-stabilized c(4 x 4) and In-stabilized c(8 x 2), were used for starting surfaces. Core-level photoemission and electron diffraction were used to study the development of the interface as a function of Sn coverage and to determine the discontinuity in the valence-band maximum. For both starting surfaces, there was evidence for some Sb segregation into the Sn films

during the initial stages of interface formation; the c(4 x 4) surface showed an earlier onset for the segregation. The Sn growth was found to be fairly flat for the first two layers, and three dimensional after that. The final valence-band discontinuity was found to be the same for both the c(4 x 4) and the c(8 x 2) starting surfaces. This discontinuity was compared to present theoretical predictions.

15434 **Stability of the strained-layer superlattice $(GaP)_1/(InP)_1$ (001).** Nelson, J.S.; Batra, I.P. (Sandia National Laboratories, P.O. Box 5800, Livermore, California 94550-5880). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3250-3253(15 Feb 1989).

First-principles total-energy methods have been used to study the stability of the strained monolayer superlattice $(GaP)_1/(InP)_1$ (001). We find a value of 4 mRy for the heat of formation, suggesting that this superlattice is unstable to disproportionation into its bulk constituent compounds. Upon formation of the superlattice, a small charge transfer from GaP to the more ionic InP is found. The Ga-P and In-P bond lengths in $(GaP)_1/(InP)_1$ are within 1% of their bulk theoretical values.

15435 **Band gaps and spin-orbit splitting of ordered and disordered Al/sub x/Ga/sub 1-//sub x/As and GaAs/sub x/Sb/sub 1-//sub x/ alloys.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3279-3304(15 Feb 1989).

Spontaneous long-range ordering of the otherwise disordered isovalent semiconductor alloys A/sub x/B/sub 1-x/C has been recently observed in numerous III-V alloy systems exhibiting the CuAu-I, CuPt, and chalcopyrite structures. We present a theory for the ordering-induced changes in the Brillouin-zone-center electronic properties, with application to the Al/sub x/Ga/sub 1-//sub x/As and GaAs/sub x/Sb/sub 1-//sub x/ alloys. The dominant effect for these systems is shown to be level repulsion between different-symmetry states of the binary constituents which fold into equal-symmetry states in the ordered ternary structures. Strong variations in the band gaps, spin-orbit splittings, and charge densities among the three basic ordered structures reflect the different magnitudes of the symmetry-enforced coupling between the folded states. An extension of the model to the disordered alloys yields good agreement with the observed optical bowing parameters for the fundamental gaps; however, the positive (downward concave) bowing of the spin-orbit splitting observed in some common-cation semiconductor alloy remains an unexplained puzzle.

15436 **Pressure dependence of the P/sub b/ center at the <111> Si/SiO_2 interface.** Johnson, N.M.; Shan, W.; Yu, P.Y. (Xerox Palo Alto Research Center, Palo Alto, California 94304). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3431-3434(15 Feb 1989).

We report the first measurement of the pressure dependence of the electronic gap states at the Si/SiO_2 interface that are associated with the paramagnetic defect termed the P/sub b/ center. The energy level of this amphoteric defect for the transition from double to single occupancy by holes is found by deep-level transient spectroscopy to shift towards the valence-band edge with increasing pressure. Our results are in agreement with the predictions of a cluster-model calculation in which the P/sub b/ center is identified with the dangling orbital of an interfacial threefold-coordinated Si atom.

15437 **Transient photoconductivity in Ge:Be due to Be^+ formation.** Haegel, N.M.; Beeman, J.W.; Luke, P.N.; Haller, E.E. (Department of Materials Science and Engineering, University of California, Los Angeles, California 90024). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 6, 3677-3682(15 Feb 1989).

The effect of the formation of the overcharged Be acceptor center, Be^+, on transient photoconductive response has been studied in Ge:Be. The response of the photocurrent to step-function changes in photon backgrounds ($\lambda = 40$ μm) is dominated by a slow transient with time constants on the order of 0.1—1.0 s at temperatures of 2—3 K. The activation energy of the hole-trapping phenomenon has been measured to be 4.3 meV. Application of 9.8 x 10^8 dyn/cm^2 uniaxial stress, sufficient to eliminate Be^+ formation, also eliminates the slow-transient response. Modeling of the transient response, in a unipolar system where the trapping mechanism is assumed to be hole trapping by Be^0, results in good agreement with the experimental results.

15438 **Simulation of silicon clusters and surfaces via tight-binding molecular dynamics.** Khan, F.S.; Broughton, J.Q. (Department of Electrical Engineering, The Ohio State University, Columbus, Ohio 43210). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 6, 3688-3700(15 Feb 1989).

A prescription is developed which incorporates the tight-binding total energy for silicon into the molecular-dynamics scheme of dynamical simulated annealing first proposed by Car and Parrinello [Phys. Rev. Lett. 55, 2471 (1985)]. The total-energy expression of Tomanek and Schlueter [Phys. Rev. Lett. 56, 1055 (1986); Phys. Rev. B 36, 1208 (1987)] with appropriate cutoff functions to permit molecular-dynamics simulations is used to calculate the forces on the ions and the electronic degrees of freedom. A self-contained description of the total-energy expression and the simulation method is presented. The scheme permits efficient quenching to zero-temperature and finite-temperature simulations of silicon clusters and surfaces. This method can perform realistic simulations on large systems of the order of hundreds of atoms with time requirements of the order of tens of Cray XMP/24 central-processing-unit hours. The prescription is tested and benchmarked on ground-state geometries of the Si_8 cluster and the reconstruction of the Si(100) surface.

15439 **Electronic properties of micro-n-i-p-i structures in silicon.** Yang, L.H.; Gallup, R.F.; Fong, C.Y.; Nelson, J.S. (Department of Physics, University of California, Davis, Davis, California 95616). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 6, 3795-3800(15 Feb 1989).

The electronic properties of ultrathin, heavily doped n-i-p-i structures in silicon have been studied with use of the ab initio pseudopotential method. Three doping configurations are used to model n-i-p-i structures by replacing silicon atoms with aluminum and arsenic atoms. The doped silicon samples are found to retain an indirect energy band gap. The heavy doping levels result in the formation of impurity bands. The top of the valence band and the bottom of the conduction band are impurity-related bands. The electron-hole charge separation even occurs when the n- and p-type impurities are nearest neighbors. The heavy doping significantly increases the electron-hole recombination matrix elements as compared to the light-doping case in which the bulk silicon band structure can be used to determine the matrix elements. However, the matrix elements for the three n-i-p-i structures in Si which were investigated are still 5 orders of magnitude smaller than those for the direct-band-gap transition in GaAs.

15440 **Photoemission spectroscopy of heterojunctions of hydrogenated amorphous silicon with silicon oxide and nitride.** Yang, L.; Abeles, B.; Eberhardt, W.; Stasiewski, H.; Sondericker, D. (Exxon Research and Engineering Company, Clinton Township, Route 22 East, Annandale, New Jersey 08801). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 6, 3801-3816(15 Feb 1989).

The growth and electronic structure of a-Si:H/a-SiN/sub x/:H and a-Si:H/a-SiO/sub x/:H heterojunctions have been studied by photoemission spectroscopy. Si 2p core-level photoemission was used to profile the chemical composition microscopically across the interfaces. With the exception of the SiO/sub x/-on-Si interface, which due to initial plasma oxidation is graded over ~3 A, the interfaces are atomically abrupt. The offset energies between the a-Si:H valence-band edge and that of a-SiN/sub x/:H and a-SiO/sub x/:H, determined by valence-band photoemission, are 1.2 and 4.0 eV, respectively. Based on the fact that the offset energy is independent of a-Si:H layer thickness down to monolayer dimensions, we concluded that hole wave functions in a-Si:H are extremely localized. From the variation of the intensity of the Si-H bonding peak, located at ~7 eV below the Fermi level, as a function of a-Si:H overlayer thickness, we determined that there are ~2 x 10/sup 15/ cm/sup -2/ extra H atoms incorporated at the interface region to compensate for the large lattice mismatch at the interface. The invariance of the Si L/sub 2,3/ absorption edge with a-Si:H

overlayer thickness indicates that the range of the core-hole exciton is less than 6 A.

15441 **Optical properties of (100)- and (111)-oriented GaInAs/GaAs strained-layer superlattices.** Laurich, B.K.; Elcess, K.; Fonstad, C.G.; Beery, J.G.; Mailhiot, C.; Smith, D.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **62**: No. 6, 649-652(6 Feb 1989).

We have studied the optical properties of GaInAs/GaAs strained-layer superlattices grown along the [100] and [111] crystallographic axes. Absorption and luminescence spectra for the two superlattices show qualitatively different behavior. These differences are attributed to the presence of strain-generated electric fields in the (111) strained-layer superlattice, which have been predicted theoretically but have not been previously observed experimentally.

15442 **X-ray measurements of thermal vacancies in hcp ^{4}He.** Fraass, B.A.; Granfors, P.R.; Simmons, R.O. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 124-131(1 Jan 1989).

Changes in the x-ray lattice parameter have been used to measure directly the thermal generation of vacant substitutional atomic sites in hcp ^{4}He crystals held at constant macroscopic volume, for samples with molar volumes in the range 20.2 to 20.9 cm^3. A progressive decrease of the apparent formation energy, from 12.6 to 8.6 K, with increase of molar volume, is seen. This variation is consistent with variations observed in the NMR diffusion activation energy for small concentrations of ^{3}He in ^{4}He. The magnitudes are also similar, with some exceptions, which suggests that, unlike hcp ^{3}He, the vacancy in low-density hcp ^{4}He moves by tunneling. By various means, values for the monovacancy free volume are deduced. Comparisons with other studies of defects in hcp ^{4}He, such as ion transport, recovery of ultrasonic attenuation, and calorimetry, are less direct and less unambiguous.

15443 **Neutron scattering measurements of critical exponents in $CsMnBr_3$: A $Z_2 \cong_1$ antiferromagnet.** Mason, T.E.; Gaulin, B.D.; Collins, M.F. (Department of Physics, McMaster University, Hamilton, Ontario, Canada L8S 4M1). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 586-590(1 Jan 1989).

$CsMnBr_3$ is an XY-like antiferromagnet on a stacked, triangular lattice with nearest-neighbor interactions. It orders antiferromagnetically at T/sub N/ = 8.3 K. We have used neutron scattering measurements of the frequency-integrated critical scattering in the paramagnetic state and magnetic Bragg peak intensity in the ordered state to determine the critical exponents γ, ν, and β. Based on these measurements we conclude that $\gamma = 1.01 +- 0.08$, $\nu = 0.54 +- 0.03$, and $\beta = 0.21 +- 0.02$. These values do not correspond to any standard universality class characterized by the dimensionality of the lattice and the order parameter. They do, however, agree with predictions by Kawamura for a universality class characterized by the symmetry of the order parameter, $Z_2 \times S_1$. This symmetry differs from that of the standard XY model (S_1) due to the presence of chiral degeneracy (Z_2), a consequence of lattice frustration.

15444 **Magnetic resonance studies of the Si-SiO/sub 2/ interface.** Brower, K.L. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

In their most recent studies the authors have examined in detail and under controlled gas ambients the effects of molecular hydrogen on the P/sub b/ center. The authors' electron paramagnetic resonance (EPR) measurements indicate that the intensity of the P/sub b/ resonance is unaffected by thermal annealing in vacuum up to at least 850°C. Thus this damaging bond defect appears to be thermally stable for temperatures up to at least 850°C. It is also observed that the P/sub b/ resonance is undetectable after thermal oxidation of the silicon followed by in situ annealing in pure hydrogen at about 300°C. This affect is commonly attributed to hydrogen passivation of the P/sub b/ center. The authors determined the thermal kinetic parameters within the context of a thermal kinetic model which characterize the passivation process as a function of time, temperature, and molecular hydrogen gas pressure. Within the context of this model they determine that the activation energy for the passivation of P/sub b/ centers with molecular hydrogen is approximately 2.0 eV. The authors' preliminary experimental results are shown. If passivated P/sub b/ centers are annealed in vacuum at temperatures in excess of 550°C, the P/sub b/ resonance reappears. Thus thermal annealing of passivated P/sub b/ centers suggests that the hydrogen is released from the defect at temperatures in excess of 550°C. The thermal kinetic parameters which characterize this dissociation process will also be presented.

15445 **Ellipsometry of electrochemical surface layers.** Muller, R.H. (Materials and Chemicals Sciences Div., Lawrence Berkeley Lab., and Univ. of California, Berkeley, CA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Ellipsometry involves the reflection of polarized light from the surface under study and the measurement of the charge in the state of polarization caused by the reflection. Ellipsometer measurements can be sensitive to surface layers of fractional monolayer coverage and can be conducted on electrodes while immersed in electrolyte. Ellipsometers can be divided into compensating and photometric types. In compensating instruments linear polarization is restored and extinguished, in photometric instruments the response of light intensity to a modulation of the state of polarization in incident of reflected light is measured. Ellipsometers can be further divided according to several other criteria. Ellipsometry has also been conducted in the infrared and microwave spectral range. Although the principles of measurement are the same as in the visible range, many of the optical components are different.

15446 **Neutron scattering from charged polymer latices.** Hayter, J.B. (Solid State Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US));. pp v of Scattering, deformation, and fracture in polymers. Wignall, G.D.; Crist, B.; Russell, T.P.; Thomas, E.L. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Aqueous suspensions of charged polymer latex particles exhibit several forms of ordered structure, the particular form depending on the size, number density and charge of the latex particles, and on the ionic strength of the aqueous medium. At low ionic strength, the inter-particle potential may become sufficiently long-ranged to generate crystalline order, which usually shows bcc symmetry at low density and becomes fcc above about 3% volume fraction of latex in the system. As the ionic strength increases, the crystalline structure melts, and ordered liquid structures develop. Light scattering may be used to study these structures at low density, but at higher density, where the opacity of the suspensions renders optical techniques intractable, neutron scattering must be used. This paper reviews some of the recent small-angle neutron scattering experiments on polymer latex suspensions, in the light of new theoretical methods which permit in situ analysis of the particle size and charge. The discussion also encompasses new experimental methods for studying latex structures under dynamic shear conditions.

15447 **A deformation-induced phase separation in the solid state.** Lefebvre, J.M.; Porter, R.S.; Wignall, G.D. (Polymer Science of Engineering, Univ. of Massachusetts, Amherst, MA (US));. pp v of Scattering, deformation, and fracture in polymers. Wignall, G.D.; Crist, B.; Russell, T.P.; Thomas, E.L. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Amorphous Polymethylmethacrylate/Polyethyleneoxide blends deformed by solid-state coextrusion exhibit anomalous anisotropic Small Angle Neutron scattering patterns in the low q range. It is shown that upon drawing the samples have undergone phase separation to some extent. The resulting structure of the system is characterized by combining scattering techniques with Differential Scanning Calorimetry.

15448 **A double-tilt small angle neutron scattering experiment on deformed polymer systems.** Saraf, R.F.; Lefebvre, J.M.; Porter, R.S.; Wignall, G.D. (Polymer Science and Engineering, Univ. of Massachusetts, Amherst, MA (US));. pp v of Scattering, deformation, and fracture in polymers. Wignall, G.D.; Crist, B.; Russell, T.P.; Thomas, E.L. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A double rotation goniometer has been mounted in the neutron beam in order to characterize the molecular deformation in polymers subjected to various strain conditions. The results provide a direct verification of the fiber symmetry in solid state coextruded polymethylmethacrylate (PMMA) and polypropylene (PP) homopolymers. In the case of the shear banding phenomenon, the authors have been able to test the validity of the simple shear assumption: it also provides a direct estimate of the finite shear strain involved in the process. As a last illustration of the method, the authors also consider the biaxial deformation of PP and PMMA squeezed under various temperature and strain-rate conditions.

15449 **Computer simulation of stress-strain behavior in polymeric materials.** Cook, R. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of Scattering, deformation, and fracture in polymers. Wignall, G.D.; Crist, B.; Russell, T.P.; Thomas, E.L. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors developed a model of polymeric materials which includes many of the features of condensed-phase polymer chain dynamics, central among them chain relaxation by conformational motion. The model consists of a number of chains of particles which are connected by bonds with double-welled potentials to approximate the energetics of conformational motion. Interactions between particles on adjacent chains are modeled by short-range repulsive potentials. They examined the stress-strain behavior of the model using molecular dynamics simulations and find qualitative agreement with the observed experimental behavior of polymeric materials.

15450 **The nature of the surface of a metal-metalloid metallic glass.** Brower, W.E.; Tlomak, P.; Kowbel, W.; Pierz, S.J. (Dept. of Mechanical Engineering and Energy Processes and Materials Technology Center, Southern Illinois Univ., Carbondale, IL (US));. pp v of Characterization of defects in materials. Siegel, R.W.; Weertman, J.R.; Sinclair, R. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The surface of a metallic glass has been characterized at the atomic and microstructural levels. On the atomic sale, the glassy surface had been previously characterized via model which allows the calculation of surface coordination numbers and the fractal dimension. Catalytic experiments and LEIS measurements appear to confirm the model's prediction of surface roughness on the atomic scale. In this work, the glassy surface has been characterized on the microstructural level via RHEED patterns. In addition, the fresh glassy surface produced by comminution of Fe-B glass has been characterized with respect to the relative stability of the comminuted glass as compared to as-quenched glass.

15451 **Surface faceting of (110) GaAs.** Parechanian-Allen, L.; Weber, E.R.; Washburn, J.; Pao, Y.C. (Dept. of Materials Science, Univ. of Calif., Berkeley, CA (US));. pp v of Characterization of defects in materials. Siegel, R.W.; Weertman, J.R.; Sinclair, R. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A systematic study has been made on (110) GaAs grown by molecular beam epitaxy. This work represents the first systematic investigation of commonly observed faceting on the (110) GaAs surface which has led to the consistent elimination of the defects. This study involved the analysis of facet geometry, a kinetic model of initial facet formation, and the electrical and optical analysis of facet free (110) GaAs. The latter was obtained with proper growth conditions and a Ga rich surface exposure from a GaAs substrate angled 6^0 toward (111)Ga.

15452 **Lanthanide refractory semiconductors based on the Th/sub 3/P/sub 4/ structure.** Gschneidner, K.A. Jr.; Nakahara, J.F.; Beaudry, B.J.; Takeshita, T. (Ames Lab., Iowa State Univ., Ames, IA (US)). pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The phase relationships and the important structural, electrical and thermal properties of the R/sub 3/X/sub 4/-R/sub 2/X/sub 3/ (where R = lanthanides and X = S, Se and Te) phases having the Th/sub 3/P/sub 4/-type structure are reviewed. The room temperature electrical resistivity and Seebeck coefficient of these materials are independent of R and only slightly dependent on X, but critically dependent on the X:R ratio. The long term stability of these phases is also reviewed. Although these materials have good thermoelectric properties there are some problems which need to be solved before these phases can be utilized in thermoelectric devices. These problems include long term stability, higher than desirable thermal conductivities, and low electron mobilities.

15453 **Nucleation and growth of silicon microstructures by direct-laser writing.** Kotecki, D.E.; Herman, I.P. (Physics Dept., Lawrence Livermore National Lab., Livermore, CA (US));. pp v of Photon, beam, and plasma stimulated chemical processes at surfaces. Donnelly, V.M.; Herman, I.P.; Hirose, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612130—).

From Materials Research Society symposium on photon, beam and plasma stimulated chemical processes at surfaces; Boston, MA, USA (1 Dec 1986).

This paper reports on a study of the nucleation phase of thin film growth during pyrolytic deposition by direct-laser writing. A Monte Carlo computer simulation is used to model the initial surface dynamics occurring during the deposition of silicon from silane (SiH/sub 4/) on strongly binding substrates such as silicon, and on weakly binding substrates such as silicon dioxide (SiO/sub 2/) and silicon nitride (Si/sub 3/N/sub 4/). Results show that for high peak temperatures ($\geq$ 1200 K) and weakly binding substrates, the most probable location for the initiation of thin film growth is radially displaced from the center of the locally laser-heated region of the surface. At low peak temperatures, thin film nucleation is found to begin at the center of the locally laser-heated surface for all substrates.

15454 **Photochemical dry etching of semiconductors and its relationship to semiconductor electronic properties.** Ashby, C.I.H. (Sandia National Labs., Div. 1126, P.O. Box 5800, Albuquerque, NM (US));. pp v of Photon, beam, and plasma stimulated chemical processes at surfaces. Donnelly, V.M.; Herman, I.P.; Hirose, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612130—).

From Materials Research Society symposium on photon, beam and plasma stimulated chemical processes at surfaces; Boston, MA, USA (1 Dec 1986).

The general utility and selectivity of photochemical dry etching processes which require direct participation of photogener-

ated carriers is largely determined by the electronic properties of the semiconductor. The laser which is used to produce the carriers responsible for etching can also provide in situ measurement of some of the important electronic properties which influence the etching process.

15455 **Constant final-state photoemission study of silicon fluoride reaction layer created during etching.** Yarmoff, J.A.; McFeely, F.R. (IBM T.J. Watson Research Center, Box 218, Yorktown Heights, NY (US));. pp v of Photon, beam, and plasma stimulated chemical processes at surfaces. Donnelly, V.M.; Herman, I.P.; Hirose, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612130—).

From Materials Research Society symposium on photon, beam and plasma stimulated chemical processes at surfaces; Boston, MA, USA (1 Dec 1986).

Soft x-ray core-level photoemission was used to study the reaction layer formed on a Si(111) surface during steady-state etching by XeF/sub 2/. These surfaces show shifted Si2p core levels which correspond to particular silicon fluoride species residing in the reaction layer. Spectra were collected in constant final state (CFS) mode for electron kinetic energies ranging from 2 eV to 90 eV. The use of CFS mode allowed the electron escape length to remain constant during individual spectra. The electron escape length for the reaction layer as a function of kinetic energy was then determined by monitoring the intensity of the bulk silicon signal. Thus, by analyzing the proportions of each silicon fluoride species observed in the individual CFS spectra as a function of the electron escape depth in the reaction layer, the distribution of the silicon fluoride species in the layer was obtained. The distribution determined placed SiF at the interface between the reaction layer and the bulk silicon, and the remaining species, SiF/sub 2/, SiF/sub 3/ and SiF/sub 4/, successively layered on top. This observation leads to a model for the structure of the reaction layer.

15456 **Laser-chemical deposition and etching on the metallization level of integrated circuits.** Johnson, A.W.; Greenberg, K.E. (Sandia National Labs., Laser and Atomic Physics Div., P.O. Box 5800, Albuquerque, NM (US));. pp v of Photon, beam, and plasma stimulated chemical processes at surfaces. Donnelly, V.M.; Herman, I.P.; Hirose, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612130—).

From Materials Research Society symposium on photon, beam and plasma stimulated chemical processes at surfaces; Boston, MA, USA (1 Dec 1986).

Laser-controlled chemical deposition and etching techniques were used to modify integrated circuits. This work used a pulsed laser to initiate and control the etching, by chlorine gas, of aluminum conductors. New conducting paths were then formed by laser-chemical vapor deposition of highly-doped silicon from silane and diborane. Improved conductivity of laser-deposited connectors was achieved by the selective deposition of tungsten on the silicon. These techniques were used to "rewire" an integrated circuit allowing the full evaluation of the corrected circuit design.

15457 **Laser microfabrication technology and its application to high speed interconnect of gate arrays.** Bernhardt, A.F.; McWilliams, B.; Mitlitsky, F.; Whitehead, J.C. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of Photon, beam, and plasma stimulated chemical processes at surfaces. Donnelly, V.M.; Herman, I.P.; Hirose, M. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612130—).

From Materials Research Society symposium on photon, beam and plasma stimulated chemical processes at surfaces; Boston, MA, USA (1 Dec 1986).

Nickel and doped polysilicon lines can be written at speeds exceeding 1000 microns/sec using laser direct-write deposition. The authors explore the roles of gas pressure, composition, and laser power in determining writing speed and line morphology. The use of a surface layer of amorphous silicon provides optical absorption, thermal and electrical insulation which help to maintain high, relatively stable, surface temperature. Laser direct-write deposition is used to interconnect CMOS gate arrays by means of computer controlled laser pantography. Complex circuits, such as an array of five 16-stage shift registers and one 16-stage counter have been successfully fabricated and tested.

15458 **Band structure and electronic excitations in Cd/sub 1-x/Mn/sub x/Te.** Wei, S.H.; Zunger, A. (Solar Energy Research Institute, Golden, CO (US));. pp v of Diluted magnetic (semimagnetic) semiconductors. Aggarwal, R.L.; Furdyna, J.K.; Von Molnar, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612132—).

From Materials Research Society symposium on diluted magnetic (semimagnetic) semiconductors; Boston, MA, USA (1 Dec 1986).

The authors have performed spin-polarized, self-consistent local spin density total energy and band structure calculations for the prototype semimagnetic semiconductor alloy Cd/sub 1-x/Mn/sub x/Te. Based on the calculated band structures and taking into account the many body effects of localized states, the author proposes a schematic energy level diagram to interpret the d→d, p→d, and photoemission transitions in Cd/sub 1-x/Mn/sub x/Te.

15459 **EXAFS determination of bond lengths in Zn/sub 1-x/Mn/sub x/Se.** Bunker, B.A.; Pong, W.F.; Debska, U.; Yoder-Short, D.R.; Furdyna, J.K. (Univ. of Notre Dame, Dept. of Physics, Notre Dame, IN (US));. pp v of Diluted magnetic (semimagnetic) semiconductors. Aggarwal, R.L.; Furdyna, J.K.; Von Molnar, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612132—).

From Materials Research Society symposium on diluted magnetic (semimagnetic) semiconductors; Boston, MA, USA (1 Dec 1986).

EXAFS has been used to determine bond lengths in the diluted magnetic semiconductor Zn/sub 1-x/Mn/sub x/Se. These alloys change from a cubic (zincblende) crystal structure to a hexagonal (wurtzite) structure as a function of composition, with the transition at $x \approx 0.3$. Although x-ray diffraction measurements show the lattice parameter to change by approximately 0.2A through the series and the crystal structure changes from cubic to hexagonal, the nearest-neighbor bond distances show no change within the experimental uncertainty of 0.01A.

15460 **The effect of Sm, Eu and Yb on the thermoelectric properties of Th/sub 3/P/sub 4/ - type lanthanum sulfide.** Nakahara, J.F.; Beaudry, B.J.; Gschneidner, K.A. Jr.; Takeshita, T. (Ames Lab., Iowa State Univ., Ames, IA (US));. pp v of Novel refractory semiconductors. Emin, D.; Aselage, T.L.; Wood, C. Pittsburgh, PA; Materials Research Society (1987). (CONF-8704266—).

From Materials Research Society symposium on novel refractory semiconductors; Anaheim, CA, USA (21 Apr 1987).

The Th/sub 3/P/sub 4/-type lanthanum sulfides are n-type semiconductors and a continuous series of solid solutions is found between the compositions of La/sub 3/S/sub 4/ and La/sub 2/S/sub 3/. These materials are attractive for use in high temperature thermoelectric applications because of their high melting points, low thermal conductivities and their inherent ability to vary the electron concentration from a maximum of 6.02 X 10/sup 21/ cm/sup -3/ for La/sub 3/S/sub 4/ to zero for La/sub 2/S/sub 3/ (i.e., self-doping). In this study, La/sub 3/S/sub 4/ compounds in which trivalent La has been partially substituted by divalent Sm, Eu or Yb (La/sub 3-x/M/sub x/S/sub 4/, $x = 0.1$ to 0.9) have been prepared by the pressure assisted reaction sintering method and were found to have the Th/sub 3/P/sub 4/ structure. The thermoelectric properties (Seebeck coefficient and electrical resistivity) were measured as a function of temperature and the optimum composition was found for x between 0.2 and 0.3 in which the electrical power factor was a maximum at 1000°C.

15461 **The connection between structural disorder and semimagnetic properties in implanted CdTe.** Jimenez-Gonzalez, H.J.; Lusnikov, A.; Dresselhaus, G.; Braunstein, G.H.; Withrow, S.P. (Massachusetts Institute of Technology, Cambridge, MA (US));. pp v of Diluted magnetic (semimagnetic) semiconductors. Aggarwal, R.L.; Furdyna, J.K.; Von Molnar, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612132—).

From Materials Research Society symposium on diluted magnetic (semimagnetic) semiconductors; Boston, MA, USA (1 Dec 1986).

The structural disorder and annealing characteristics of dilute magnetic semiconductors synthesized by implantation of Mn ions into CdTe are studied. After implantation but prior to annealing, the implanted Mn ions reside at random sites in a highly disordered CdTe lattice. To separate magnetic and nonmagnetic effects the authors have implanted CdTe with nonmagnetic Zn ions under the same conditions as the Mn ions (energy 60 keV, fluence 10/sup 16/cm/sup -2/). Various annealing conditions are applied to monitor the decrease in intensity of the disorder-induced photoluminescence peaks and the increase of the peak intensity of the CdTe-like exciton line is reduced.

15462 **Magnetic specific heat of Cd/sub 1-x/Mn/sub x/Te at low temperatures and high magnetic fields.** Ching, W.Y.; Huber, D.L. (Dept. of Physics, Univ. of Missouri-Kansas City, Kansas City, MO (US));. pp v of Diluted magnetic (semimagnetic) semiconductors. Aggarwal, R.L.; Furdyna, J.K.; Von Molnar, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-8612132—).

From Materials Research Society symposium on diluted magnetic (semimagnetic) semiconductors; Boston, MA, USA (1 Dec 1986).

Theoretical predictions for the magnetic specific heat of Cd/sub 1-x/Mn/sub x/Te:x=0.20, 0.35, 0.50, and 0.65 are reported for B=O, 10T, and 100T. The analysis applies to the low-temperature regime, T≦10K, where the fundamental excitations are harmonic magnons. The calculations use values for the exchange interactions which were inferred from fits to the dynamic structure factor describing inelastic neutron scattering at low temperatures. For x=0.35, 0.50, and 0.65 the specific heat is only weakly affected by applied fields up to 10T. At the lowest concentration the application of a field of 10T leads to a significant reduction in the specific heat. Results are also presented for the distribution of magnon modes at various concentrations and fields.

15463 **Selective laser-induced photochemical dry etching of semiconductors controlled by ion-bombardment-induced damage.** Ashby, C.I.H.; Myers, D.R.; Vook, F.L. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. Pennington, NJ; The Electrochemical Society (1987). (CONF-871027—).

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

When a photochemical dry etching process requires direct participation of photogenerated carriers in the chemical reaction, it is sensitive to the electronic properties of the semiconductor. For such solid-excitation-based dry etching processes, the balance between reaction and carrier recombination rates determines the practical utility of a particular reaction for device fabrication. The distance from the surface at which the photocarriers are generated by light adsorption is determined by the absorption coefficient. In the absence of an external bias potential, only those carriers formed within a diffusion length of the surface space-charge region will have an opportunity to drive the dry etching reaction. When the absorption coefficient is high, most of the photons generate carriers within a diffusion length from the surface space-charge region, and the etching rate is largely determined by the balance between the rate of the carrier-driven reaction and the surface recombination velocity. When the recombination rate of free carriers in the bulk of the semiconductor is high, the effective diffusion length is reduced and fewer of the carriers generated in the subsurface region ever reach the surface. An important effect of ion bombardment is the creation of many lattice defects that increase the rate of recombination of electrons and holes. When a sufficient number of defects, which act as recombination sites, are formed during ion implantation, the recombination of photogenerated carriers at these defects in the subsurface region can greatly reduce the number of carriers which can reach the surface and drive a photochemical etching reaction.

15464 **Material considerations in the microfabrication of grating microstructures for use in a laser-powered linear accelerator.** Warren, J.B. (Brookhaven National Lab., Upton, NY (US));. pp v of Science and technology of microfabrication. Howard, R.E.; Hu, E.L.; Namba, S.; Pang, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Collaborative work between Brookhaven and Los Alamos National Laboratories is developing a new type of linear accelerator that uses a high-ower, a picosecond pulse CO/sub 2/ laser toirradiate a specialized form of grating with a pitch of 10.6 microns. The electromagnetic field that results can be used to accelerate electrons at field gradients of several GeV/m with potential efficiencies much better than current accelerators. The grating must be conductive to minimize resistive looses, be able to withstand high fields without damage, and requires dimensional tolerances in the sub-micron range. These requirements focus attention on grating material selection, microfabrication methods, and metrological methods used for quality control. At present, several types of gratings have been manufactured by reactive ion etching of fused silica in CHF/sub 3//Ar or etching silicon with KOH/H/sub 2/O or ethylenediamine-pyrocatechol solutions. Metrological analysis of the gratings has begun with a Tracor Northern 5700 digital image analyzer.

15465 **The corrosion of carbon black anodes in alkaline electrolyte.** Staud, N.; Ross, P.N. Jr. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Berkeley, CA (US));. pp v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. Pennington, NJ; The Electrochemical Society (1987). (CONF-870560—).

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

A selection of furnace black carbons of varying surface area and industry type were heat treated in purified helium at 2700°C and the corrosion resistance measured under conditions of oxygen evolution in 30% KOH at 55°C. The extent of graphitization was determined by x-ray diffraction and by high resolution transmission electron microscopy. The experimental methods for corrosion measurement followed those reported previously.

15466 **The characterization of silicon damaged by low energy argon ion etching.** Seager, C.H.; Panitz, J.K.G.; Pettit, R.G.; Brice, D.K. (Sandia National Labs., Albuquerque, NM (US));. pp v of Science and technology of microfabrication. Howard, R.E.; Hu, E.L.; Namba, S.; Pang, S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors have used a variety of characterization techniques including electron spin resonance (ESR), photothermal deflection spectroscopy (PDS), ellipsometry, and I-V and C-V analysis to study silicon samples damaged by ballistic penetration calculations, PDS and ellipsometry data show that the majority of the lattice damage lies within 40 A . of the surface. The ellipsometry results are well modelled as a thin, damage induced layer of an-Urbach-like subgap adsorptance tail. In addition to Schottky barrier height alterations produced by Ar bombardment. They also observe marked changes in electrically active dopant densities in boron doped silicon samples. C-V analyses show that these changes extend quite far (1-2 μm) into the sample and are readily removed by a mild (150°C) thermal anneal. Hydrogen, injected from surface absorbed H/sub 2/O or hydrocarbons, appears to be the source of these effects. The authors also discuss their upper limit estimate of 10/sup 13/ "dangling bond" spins/cm/sup 2/ for their damaged samples in light of prior ESR observations on similarly treated surfaces.

15467 **Radiation damage in silicon due to albedo neutrons emitted from hadronic beam dumps (Fe and U).** Gabriel, T.A.; Bishop, B.L. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

Calculations have been carried out to determine the level of radiation damage that an be expected from albedo neutrons when 1- and 5-GeV negative pions are incident on iron and uranium beam dumps. The calculated damage data are presented in several ways including neutron fluence above 0.111 NeV, 1 MeV equivalent neutron fluence, damage energy deposition, and DPA or displacements per atom. Details are presented as to the method of calculation.

15468 **(SU/FAS—AES/SAG1-2:86-20) Strength development of concrete cured under Arctic conditions.** Aitcin, P.C.; Cheung, M.S.; Shah, V.K. (Sherbrooke Univ., Quebec (Canada). Faculty of Applied Science). 1986. 39p. (CE—02297). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

To simulate curing conditions of concrete caisson construction in Arctic offshore structures, two sets of experiments were carried out--one at a laboratory and the other in the field at a site in Baffin Island. Over 500 concrete specimens were tested during the initial curing periods and at various ages. The results showed that if the concrete is allowed to cure at 0/sup 0/C for 9 h before immersion in sea water at 0/sup 0/C, the design compressive strength of the concrete can be achieved in 56 days. During the first few days of such a curing, the compressive strength increases very slowly; however, the 28 and 56 days compressive strengths of specimens cured in such harsh conditions can be about the same as that of companion specimens cured under water at room temperature. The Young modulus of concrete cured at such a low temperature is lower than that of a similar concrete cured at room temperature. The initial temperature of the concrete, its water/cement ratio, and the type of cement are critical factors that influence significantly the initial compressive strength of the concrete. 6 refs., 13 figs., 12 tabs.

15469 **X-ray investigation of strained metal-hydrogen superlattices.** Miceli, P.F.; Zabel, H.; Cunningham, J.E. (Dept. of Physics and Materials Research Lab., Univ. of Illinois, Urbana, IL (US));. pp v of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The properties of strained superlattices can be studied in a tunable fashion by dissolving hydrogen interstitially in strain free Nb/Ta metal superlattices. The authors report on a first investigation of a Nb/Ta 20 A superlattice loaded with hydrogen in-situ in a high temperature x-ray furnace. After hydrogen uptake the +- 1 satellite reflections show pronounced asymmetries, indicating a hydrogen density distribution which is modulated by the superlattice periodicity.

15470 **Amorphous and crystalline phase formation by ion-mixing of Ru-Zr and Ru-Ti.** Cheng, Y.T.; Johnson, W.L.; Nicolet, M.A. (California Institute of Technology, Pasadena, CA (US));. pp v of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Ion mixing of multilayered Ru-Zr and Ru-Ti at different compositions and substrate temperatures produced various metastable phases. The applicability of previously proposed rules regarding amorphous phase formation are examined. Effects of point defect in amorphous phase formation by ion mixing are discussed.

15471 **Solid-phase ohmic contacts to GaAs with TiN diffusion barriers.** Kattelus, H.P.; Tandon, J.L.; Hamdi, A.H.; Nicolet, M.A. (California Institute of Technology, Pasadena, CA (US));. pp v of Layered structures, epitaxy, and interfaces. Gibson, J.M.; Dawson, L.R. Pittsburgh, PA; Materials Research Society (1985). (CONF-841157—).

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The authors report on contacts to p-type GaAs formed by a GaAs/Pt/TiN/Ag system. Ohmic behavior in this system is believed to be accomplished by the solid-state reaction of Pt with GaAs. This reaction is confined by the TiN film which is thermally stable. In addition, the TiN film acts as an excellent diffusion barrier in preventing the intermixing of the top Ag layer with GaAs or Pt. Contacts formed with such controlled reaction have important implications for the stability of shallow p-n junction devices.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 14857

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REFER ALSO TO CITATION(S) 14132, 14198, 14359, 14427, 14435, 14436, 14437, 14455, 15198, 15212, 15216, 15218, 15311, 15322, 15326, 15331, 15336, 15375, 15385, 15455, 15466, 15523, 15532, 15550, 15578, 15681, 16013, 16138, 16140, 16147, 16416, 16416, 16621, 16795

15472 **(AERE-R—13065) Study of benchmark matrix effects in the neutron die-away assay of fissile material in 200l drums.** Armitage, B.H.; Cogbill, M.J. (UKAEA Harwell Lab. (UK). Nuclear Physics and Instrumentation Div.). Sep 1988. 20p. H.M. Stationery Office, London, price Pound 8.00.

An experimental study of the effects of eighteen different matrices on the accuracy of fissile material assay in 200l drums has been reported previously. In it a procedure was specified, and the limits of applicability given, whereby fissile material assay by the neutron die-away technique can be effectively undertaken without a knowledge of the matrix. This work has been successfully extended to include the effects of matrices typical of BNFL waste arisings, and the results are presented in this paper. Three benchmark matrices described as non-combustible and shreddable have been examined with the result that the mean compensated response for the matrices together with that of a matrix-free drum vary from 0.97 to 1.16. Although assay errors for the non-combustible matrices are greater than in the earlier more comprehensive study, the matrices themselves are significantly more absorbing to thermal neutrons.

15473 **(CBPF-NF—044/88) Determination of Fe and Ni ordering in tetrataenite from Saint Severin using Synchrotron radiation.** Tagai, T.; Takeda, H.; Tokonami, M.; Sasaki, S.; Danon, J. (Tokyo Univ. (Japan). Mineralogical Institute; Photon Factory, Ibaraki (Japan)). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705407/JAW.

The experimental results of the single crystal of tetrataenite using synchrotron radiation, wich is characterized by its strong intensity and the tunable wave length, are presented. (M.C.K.).

15474 **(CEA-CONF—9569) New technique for the measurement of kinetic constants of transfer between liquids.** Musikas, C.; Simonin J.P.; Soualhia, E.; Turq, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif; Paris-6 Univ., 75 (FR)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1988. 4p. (CONF-8807136—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756408/JAW.

From ISEC '88: international solvent extraction conference; Moscow, USSR (18 Jul 1988).

A technique inspired by the rotating cell of Albery is presented in this paper. It consists of a capillary that can be rotated,

filled with an aqueous solution A of radioactive isotope and immersed in an organic solution of extractant B. Inside the capillary the solution is freed from convection with the help of agarose. In A a pure diffusion occurs and in B a convective flow of the rotating electrode kind. Experimental verification is realized for transfer of Cobalt ion from water towards HDEHP diluted in dodecane using cobalt 57 as a tracer.

15475 **(CEA-tr—2256) RFAA-30 automatic analyser for in situ determination of traces of Fe, Ag, Cu, Zn, Sn, W, Mn, U, rare earths and other elements by characteristic X rays excited by radionuclides.** Bruchertseifer H.; Eckert, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1988. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756665/JAW.

The RFAA-30 automatic analyzer for in-situ determination of trace element content of Fe, Ag, Cu, Zn, Sn, W, Mn and U is described in the domain ppM. 10-minute measurement allow the determination of O.O5mg/l of these metals with certainty. The RFAA-30 is specially designed for process control and laboratory analysis.

15476 **(CIEMAT—618) Determination of Ra-226 by gamma-ray spectrometry.** Martinez, A. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 38p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756335/JAW.

This work deals with the method of determination of Ra-226 by Low Energy Photon Spectrometry. For this purpose, the interference due to U-235, that emits a photon with a close energy, has to be considered. The contribution of U-235 to the 186 KeV photopeak is studied through the 63 KeV Th-234 and the 144 KeV U-235 emissions. From the minimum dsetectable activity or Ra-226 it is discused the applicability of this method to several kind of samples. (Author)

15477 **(CIEMAT—621) The application of computers to the processing of data in spectrographic analysis.** Rucandio, M.I.; Roca, M. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 44p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756338/JAW.

Two mutually connected programs have been written in BASIC language for performing the following tasks: (1) Calibration of the photographic emulsion by the two step procedure, being obtained by the lest squares fit method both the preliminary curve and the calibration curve (the latter in polynomial steps of first to third dsegree). (2) Establishment, also in polynomial steps, of the working curve for each element and calculation of the corresponding concentrations in the samples, being used the calibration equations obtained and stored by the preceding program for converting the transmittances to intensities. (Author)

15478 **(CIEMAT—623) Preparation and standardization of a sample of ^{32}P by liquid scintillation.** Rodriguez, L.; Grau, A.; Los Arcos, J.M.; Suarez, C. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 26p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756340/JAW.

A procedure to standardize ^{32}P in liquid scintillation counting by labelling a tributyl phosphate organic molecule is described. This method shwos a high countin efficiency, over 99%, while keeping a good stability of samples in PCS or toluene, which vary less that 1% in two weed periods. The global uncertai.(Author)

15479 **(DOE/ER/13256—5) Continuous chemical reaction chromatography: Progress report, December 1985--December 1988.** Aris, R.; Carr, R.W. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). [1989]. Contract FG02-84ER13256. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006077/JAW.

During the present three year project period we have been investigating continuous gas chromatographic separations, and continuous reaction gas chromatography of solid catalyzed reactions in a countercurrent moving bed. Design and construction of a computer controlled laboratory scale countercurrent moving bed apparatus was completed. In the countercurrent moving bed, a granular solid (typically 30-50 mesh) flows slowly down a vertical tube against an upflowing carrier gas. A mixture to be separated, or a reactant species, is fed continuously at an arbitrary location along the column. We have now carried out experimental investigations of separation of a binary mixture, 1,3,5-trimethylcyclohexane and 1,3,5-trimethylbenzene, and of hydrogenation in the countercurrent moving bed. 8 refs., 2 tabs.

15480 (IA—1440, pp 294-295) **Neutron-activation-analysis for geological purposes.** Altman, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15481 (IA—1440, pp 292-294) **Gamma spectroscopy for determining uranium, thorium and potassium concentrations of geological samples.** Vulkan, U.; Lifschitz, G.; Altman, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15482 **(INFN-TC—88-27) PIXE analysis of tree leaves as a possible comparative integral monitor of particulates in urban areas.** Zucchiati, A.; Annegarm, H.J.; Chisci, R. (Istituto Nazionale di Fisica Nucleare, Genoa (Italy); University of the Witwatersrand, Johannesburg (South Africa); Ospedale Galliera, Genoa (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705504/JAW.

The possibility of obtaing integral comparative data for particulate distribution in urban areas from PIXE analysis of tree leaves is discussed in relation to the leaf gross anatomy, to the diffusion of selected tree species in such areas and to the implementation of experimental techniques necessary to make PIXE analysis effective. Multielemental scans were performed on a small set samples; results are compared to PIXE analysis of typical urban aerosols. The validity of the method and the criteria for yearly relative comparisons of different areas are discissed.

15483 **(ININ-GSTN—001-87) Quantitative analysis of heavy metals in water samples of the Chapala lake by X-ray fluorescence analysis.** Perez Novara, Ana Ma. (Instituto Nacional de Investigaciones Nucleares, Mexico City). (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jan 1987. 6p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705377/JAW.

Seven samples of water from Chapala Lake were sent to the ININ X-Ray Fluorescence Laboratory. The presence of Fe, Ni, Cu, Hg and Pb in general could be observed, The results for Pb and Hg were compared with those obtained by atomic absorption in laboratories at the SARH (Ministry of Agriculture and Hydraulic Resources). Corrections had to be made in order to quantify the amount of mercury. There are good working conditions to perform routine analyses of heavy metals ions in water.

15484 **(ININ-GSTN-RX—1-86) Heavy metals analysis in fishes by the X-ray fluorescence method.** Perez Novara, Ana Ma. (Instituto Nacional de Investigaciones Nucleares, Mexico City). (Instituto Nacional de Investigaciones Nucleares, Mexico City). Apr 1986. 13p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705379/JAW.

Among the sources of contamination in human beings we find ingestion of heavy metals. As it is common practice to pour industrial wastes in waters where fishes feed, some toxic elements present in water may pass to human beings through ingestion. It is

therefore important to determine the concentrations of heavy metals present in fishes, mainly in those living in waters close to industrial zones or villages. Concentrations of heavy metals in tissue of fishes amount to ppm, hence making necessary the use of very sensitive analytical techniques which do not require a too complex preparation of the sample in order to avoid the loss or contamination of interesting elements of analysis while handling them, thus falsifying the results. The X-Ray Fluorescence method covers these requirements and is not destructive nor multi-elemental. The development of the technique of element analysis in fishes by X-Ray Fluorescence comprised several aspects. from sampling and storage to quantification, specially stressing the preparation of samples. The work was carried out with a Si-Li detector/monitor for solid state and associated electronic equipment. Cd-109 and Pu-238 sources were used to produce excitation, detection limits near 1 ppm were obtained in the majority of elements the technique attained for the analysis of this kind of samples fulfills the celerity, precision, accuracy, and sensitivity requirements.

15485 **(INIS-BR—1394) Simultaneous determination of uranium and thorium in coal ashes by X-ray fluorescence.** Carvalho, M.S. de; Mantovano, J.L.; Trindade, H.; Alleluia, I.B. (Bahia Univ., Salvador (Brazil)). 1987. 2p. (In Portuguese). (CONF-8709392—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88705508/JAW.

From 2. International Environmental Chemistry Congress; Salvador, Brazil (16 Sep 1987).

15486 (INIS-mf—11348, pp 29) **Determination of tin, antimony and cadmium in biological material by activation analysis.** Lopez, C.; Cohen, I.M. (Instituto Nacional de Investigaciones Nucleares, Mexico City; Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15487 (INIS-mf—11348, pp 55) **Criticism of age determination methods based on radiation induced defects.** Apers, D. (Louvain Univ. Louvain-la Neuve (Belgium). Laboratoire de Chimie Inorganique et Nucleaire). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15488 (INIS-mf—11348, pp 95) **Analytical application of some threshold and secondary reactions produced in nuclear reactors.** Cohen, I.M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15489 (INIS-mf—11348, pp 127) **Experimental behavior of chi squared in enhancing the statistical significance of a Mossbauer spectrum.** Cabral P, A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15490 (INIS-mf—11348, pp 129) **Mossbauer characterization of Fe(Fe(HMoO4)6).14H2O and (NH4)3(Fe(HMoO4)6).xH2O.** Cabral P, A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15491 (INIS-mf—11348, pp 131) **Determination of activation analysis sensitivity levels, using a low intensity neutron source.** Rios M, C.; Vega C, H.R.; Ramirez O, J.A. (Universidad Autonoma de Zacatecas (Mexico). Centro Regional de Estudios Nucleares; Universidad Autonoma de Zacatecas (Mexico). Escuela de Ciencias Quimicas). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15492 (INIS-mf—11348, pp 133) **Analysis of aztec ceramic by PIXE and HEHIXE.** Tenorio, D.; Jaidar, A. (Instituto Nacional de Investigaciones Nucleares, Mexico City; Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Fisica). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15493 (INIS-mf—11348, pp 58) **Quantitative spectrographic analysis of impurities in aluminium.** Rodriguez Loya, R.; Abascal Garrido, F.; Barragan Rios, G.J. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15494 (INIS-mf—11348, pp 64) **Quantitative determination of D2O by infrared spectrophotometry in concentration ranges from 0.015% to 1.0%.** Hernandez F, A.; Garcia S, M. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15495 (INIS-mf—11348, pp 84) **Long half-life isotopes from the 4n+2 radioactive series in carnotite.** Garcia-San Juan, M.; Jimenez R, M. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15496 (INIS-mf—11348, pp 111) **Quantitative analysis of rare earths by x-ray fluorescence.** Moreno B, E.; Perez Novara, A.M. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15497 (INIS-mf—11348, pp 123) **Quantitative analysis of impurities in uranium oxide using atomic absorption spectrometry.** Rodriguez G, E.; Abascal G, F.; Benavides M, A.M. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15498 (INIS-mf—11348, pp 139) **Determination of commercial karats on gold alloys for jewellery by X-ray fluorescence analysis.** Morales, S.E.A. (Direccion General de Energia Nuclear, Guatemala City (Guatemala)). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15499 (INIS-mf—11348, pp 82) **Electrodeposition separation of polonium-210.** Ordonez R, E.; Iturbe, J.L. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15500 (INIS-mf—11348, pp 90) **Preferential elution of 99mTc from zeolites labelled with 99Mo.** Olguin, M.T.; Dominguez E, J.M.; Bosch, P.; Bulbulian, S. (Instituto Mexicano de Petroleo, Mexico City; Universidad Autonoma Metropolitana, Mexico City. Div. de Ciencias Basicas y Ingenieria; Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15501 (INIS-SU—68, pp 516) **Study of hydrogen distribution profile in samples.** Gusinskij, G.M.; Kudryavtsev, I.V.; Najdenov, V.O.; Rassadin, L.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15502 (INIS-SU—68, pp 517) **Analysis of hydrogen in dielectric metal oxide films by recording proton recoil spectra.** Gusinskij, G.M.; Karpukhina, L.G.; Kudryavtsev, I.V. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15503 (INIS-SU—68, pp 525) **Use of resonance (α,α)-scattering for the analysis of thin oxide films.** Artsimovich, M.V.; Drobachenko, O.V.; Lutsaj, N.S. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15504 (INIS-SU—68, pp 526) **Combined X-ray fluorescence analysis.** Blyakher, E.V.; Korneva, Z.N.; Krymskaya, N.A.; Shirokobrod, O.E.; Ter-Nersesyants, V.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15505 (INIS-SU—68, pp 546) **Advantage of nuclear microprobe in local microprobe analysis.** Puzyrevich, A.G.; Shipilov, A.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15506 (INIS-SU—68, pp 547) **Study of charge accumulation effect in dielectric in X-ray analysis with ion microprobe.** Puzyrevich, A.G.; Ryabchikov, A.I.; Shipilov, A.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15507 (INIS-SU—68, pp 561) **Nuclear-spectrometric analysis of soil.** Novikov, A.I.; Stolyarova, E.L.; Savel'ev, I.B.; Chelyshev, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15508 (INIS-SU—68, pp 566) **Nuclear method for calibration of system of rapid analysis of protein content by /sup 14/N(d,p)/sup 15/N reaction.** Lyubarskij, V.A.; Melenevskij, A.Eh.; Nemykin, V.I.; Shimanov, O.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15509 (INIS-SU—68, pp 567) **Nuclear rapid measuring / sup 15/N isotope tracer in biological samples.** Vinogradova, T.I.; Lyubinskij, N.N.; Melenevskij, A.Eh.; Nemykin, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15510 (INIS-SU—68, pp 568) **Carbon, nitrogen and oxygen content measuring in biological samples by deuteron activation.** Vinogradova, T.I.; Melenevskij, A.Eh.; Nemykin, V.I.; Semenyuta, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15511 (INIS-SU—68, pp 571) **Use of heavy ions for element analysis.** Mayatskij, V.D.; Pucherov, N.N.; Chesnokova, T.D. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15512 (INIS-SU—68, pp 574) **Study of the composition of medicinal preparations of vegetable origin by neutron activation method.** Badalov, N.B.; Omonov, Sh.; Tillaeva, Kh.; Mukhamedov, S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15513 (INIS-SU—68, pp 578) **Use of proton backscattering nuclear method for nitrogen concentration determination in titanium.** Romanovskij, E.A.; Nguen Mak Kha; Bespalova, O.V.; Borisov, A.M.; Galakhmatova, B.S.; Goryaga, N.G.; Kordyukevich, O.V.; Petukhov, V.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15514 **(LA—11454-MS) Quality assurance for health and environmental chemistry: 1987.** Gautier, M.A.; Gladney, E.S.; Phillips, M.B.; O'Malley, B.T. (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 352p. NTIS, PC A16/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007125/JAW.

This report documents the continuing quality assurance efforts of the Health and Environmental Chemistry Group at the Los Alamos National Laboratory. The philosophy, methodology, and computing resources used by the quality assurance program to encompass the diversity of analytical chemistry practiced in the group are described. Included in the report are all quality assurance refer-

ence materials used, along with their certified or consensus concentrations, and all analytical chemistry quality assurance measurements made by HSE-9 during 1987.

15515 (ZfK—584, pp 63) **Plastic foils as primary hydrogen standards for nuclear reaction analysis.** Rudolph, W.; Bauer, C.; Brankoff, K.; Grambole, D.; Groetzschel, R.; Heiser, C.; Herrmann, F. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15516 (ZfK—584, pp 72) **Depth distribution of F, Na, and P in tooth enamel measured by means of nuclear reactions.** Zschau, H.E.; Vogt, J.; Otto, G. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15517 (ZfK—584, pp 77) **Use of secondary ion mass spectrometry for steel analysis.** Mechahougui, S.; Lehmann, G.; Mueller-Jahreis, U. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15518 (ZfK—584, pp 78) **Method of quantification of mass spectra in secondary ion mass spectrometry (SIMS).** Duesterhoeft, H.; Lueders, A. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15519 **Interference between second-harmonic generation from a substrate and an adsorbate layer.** Berkovic, G.; Shen, Y.R.; Marowsky, G.; Steinhoff, R. (Department of Physics, University of California, Berkeley, Berkeley, California 94720). *Journal of the Optical Society of America B: Optical Physics;* 6: No. 2, 205-208(Feb 1989).

Several experiments on surface second-harmonic generation are presented to show how the contribution from a transparent substrate can interfere with that from an adsorbate monolayer. The interference depends on the relative phase of the two contributions, which varies with the molecular orientation, the laser frequency, the polarization, and the optical geometry.

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REFER ALSO TO CITATION(S) 14160, 14195, 14198, 14207, 14275, 14304, 14307, 14316, 14398, 14473, 14481, 14552, 14893, 15102, 15202, 15203, 15208, 15225, 15227, 15230, 15231, 15232, 15233, 15235, 15412, 15445, 15446, 15610, 15996, 16157, 16251, 16282, 16576, 16826

15520 **(AERE-R—13197) Absorption of volatile ruthenium.** Cains, P.W.; Barnes, S.J.; Frankish, P.; Delaney, M.; Waring, S. (UKAEA Harwell Lab. Chemical Engineering Div.; Department of the Environment, London (UK)). Jul 1988. 56p. (DOE-RW—88.096). H.M. Stationery Office, London, price Pound 12.00.

Phase equilibrium and mass transfer measurements for the absorption of ruthenium tetroxide (RuO/sub 4/) in aqueous and nitric acid solutions have been completed. Low concentration phase equilibrium measurements confirm that the system obeys Henry's law across 4 orders of magnitude in concentration. Mass transfer measurements from turbulent gas flow indicate that the diffusivity of RuO/sub 4/ in air may increase slightly as its concentration is reduced by 5-6 orders of magnitude. The reaction of RuO/sub 4/ with nitrous acid and nitrites in solution results in precipitated or colloidal RuO/sub 2/. Initial, immediate decomposition of ~ 50% of the RuO/sub 4/ occurs at RuO/sub 4/: HNO/sub 2/ mole ratios between 10:1 and 1:2, and does not vary systematically with mole ratio in this range. A mathematical model of the RuO/sub 4/ decontamination performance of a packed bed scrubber has been developed, and validated experimentally with a laboratory QVF system. A survey of modelling approaches for predicting the ruthenium decontamination performance of off-gas condensers has been carried out.

15521 **(CNEA-NT—32/87) Stable and metastable equilibrium states of the Zr-O system.** Versaci, R.A.; Abriata, J.P.; Garces, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Materiales; Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1987. 53p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705413/JAW.

The precise knowledge of the phase diagrams is of fundamental importance for the comprehension of processes like soldering and thermal treatment. The Zr-O diagram has been widely studied, mainly in the zone corresponding to ZrO/sub 2/. A critical analysis of the existing information about this diagram is presented. Furthermore, a lot of information about the phase equilibrium, metastable phase, crystal structure, thermodynamic properties and a possible diagram for pressures higher than one atmosphere is presented. (M.E.L.).

15522 **(DOE/ER/13296—5) Ligand transformations and catalysis by transition metal cluster compounds containing sulfur: Progress report, 1986--1988.** Adams, R.D. (South Carolina Univ., Columbia (USA). Dept. of Chemistry). Dec 1988. Contract FG09-84ER13296. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006646/JAW.

We have conducted extensive investigations into the nature of multicenter based ligand transformations in a variety of metal cluster complexes containing sulfido or sulfur-containing ligands. These investigations have resulted in the preparation of several new cluster complexes containing thioformaldehyde ligands and the first cluster complexes to contain thioformyl ligands. We have discovered new routes to cluster complexes containing aminocarbene ligands, and have prepared the first cluster complexes to contain triply bridging aminocarbene ligands and the first cluster complexes containing iminium ligands. We have prepared several new cluster complexes containing ynamine ligands and performed the first structural characterization of such a complex. Most importantly, most of these complexes have been shown by us to engage in novel multicenter ligand transformations. We have investigated a new mixed-metal cluster complex for its ability to produce alkyne oligomerization and have found that the mixed-metal complex exhibits some ligand transformation properties that its homonuclear components do not have. Finally, we have discovered some new cluster complexes that are capable of performing the tertiary amine metathesis reaction catalytically. We have performed numerous experiments to ascertain the mechanism(s) of these processes and are now on the verge of presenting detailed analyses. A summary of these results are contained in the following sections. 2 figs.

15523 **(DOE/ER/13357—4) Interfacial chemistry in solvent extraction systems: Progress report, June 1, 1988--May 31, 1989.** Neuman, R.D. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). Jan 1989. Contract FG05-85ER13357. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006582/JAW.

Excellent progress has been made in our research program investigating the interfacial chemistry in solvent extraction systems. Our present research is emphasizing characterization of the structure and dynamics of the macroscopic liquid/liquid interface in hydrometallurgical solvent extraction systems. Two advanced laser techniques, surface laser light scattering (SLLS) and fluorescence recovery after photobleaching (FRAP), are to be applied to both model extractant films and liquid/liquid interfaces of solvent extraction systems to provide new fundamental information on the inter-

facial properties of such systems. Pioneering investigations are also in progress investigating the nature of the molecular aggregates or microstructures existing in the bulk organic phase of solvent extraction systems. Some highlights of our recent accomplishments are summarized.

15524 **(DOE/ER/13451—4) Studies of hydrogen-hydrogen and carbon-sulfur bond cleavage: Progress report, August 1986--July 1989.** DuBois, M.R. (Colorado Univ., Boulder (USA). Dept. of Chemistry and Biochemistry). 1989. Contract FG02-85ER13451. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006116/JAW.

The primary goals of research were to synthesize new cationic dinuclear complexes and to further characterize the novel reactivity of the cations with hydrogen. These studies were proposed to have potential for providing relevant homogeneous models for hydrogen activation and hydrogenolysis reactions on molybdenum sulfide surfaces. Results in the following areas are discussed: synthesis of cations; reaction of the methylthiolate cation with H_2 to form a neutral derivative with an SH ligand; hydrogen activation as a function of thiolate substituent; effect of base on reactions; kinetics of hydrogen activation; reactions of Mo complexes with acyl halides and hydrogen; reactions of hydrogen with cations containing unsaturated thiolate; cation studies with a thiolate substituent; one electron reduction of cations; reactions of cations with nucleophiles; and oxidation chemistry. (CBS)

15525 **(DOE/ER/13772—T1) Surface analyses and modelling of rate multiplicity and instabilities: Annual progress report, September 1, 1987--December 31, 1988.** Harold, M.P.; Conner, W.C. (Massachusetts Univ., Amherst (USA). Dept. of Chemical Engineering). 1988. Contract FG02-87ER13772. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006498/JAW.

A large class of noble metal catalyzed reactions exhibit multiple rate phenomena and oscillatory behavior. Thus, it is essential to monitor a catalyst surface with a spatially uniform temperature during an oscillatory state. Such data would help to identify the main communication mechanisms for surface synchronization (or its absence). This research consists of two different studies: The first study couples nonlinear mathematical tools with careful kinetics experiments involving the oxidations of carbon monoxide, formaldehyde, and methanol on an electrically heated platinum wire. Operating regimes in which rate multiplicity exists are determined by locating the bifurcation (ignition and extinction) point. A wide range of total pressures (760 to 0.1 torr) are spanned to access the impact of transport limitations. Singularity theory techniques are used to analyze intrinsic rate multiplicity data for determining the best kinetic model based on the ability to predict the location of the multiplicity region. Results on CO oxidation are reported. The second study involves the development of a novel scanning Fourier transform infrared emission spectroscopic technique to study kinetic instabilities exhibited by reactions carried out on a platinum foil. 7 refs., 9 figs.

15526 **(ECN—88-173) Thermochemical properties of the alkali hydroxides. A review.** Konings, R.J.; Cordfunke, E.H. (Netherlands Energy Research Foundation, Petten). Nov 1988. 28p. Stichting Energieonderzoek Centrum Nederland, P.O. Box 1, 1755 ZG Petten, Netherlands.

The formation of volatile alkali hydroxides as a result of high-temperature steam corrosion plays an important role in nuclear technology. For the modeling of the volatilization processes, reliable thermodynamic data are required. Recent physico-chemical experiments are discussed and the thermochemical properties of the alkali hydroxide series are evaluated. 6 figs., 66 refs., 7 tabs.

15527 **(FRCEA-TH—166) Synthesis and reactivity of uranium (III) cyclopentadienyl complexes.** Foyentin, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie; Paris-11 Univ., 91 - Orsay (France)). 1987. 128p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756442/JAW.

New uranium organometallic complexes are synthetized from the addition compound Cp U (THF). Reactions with lithium compounds, chlorides, alkynes and borohydrides. Oxidizing addition reactions are evidenced with alkyl halogenides. With a strong reducing agent, the complex Cp-UCH-Li allows the fixation and the reduction of nitrogen into ammonia. Lability of ligands bound to U (III) is evidenced, giving very reactive species and hence catalytic properties for these compounds. Catalytic hydrogenation of olefins is studied. Substitution reactions of alkyl groups of these complexes with olefins in presence or not of hydrogen or with alkyllithium are original.

15528 **(FRCEA-TH—167) Structure studies of uranium complexes with macrocycles in solid phase and in solution.** Dejean de la Batie, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-11 Univ., 91 - Orsay (France)). 1986. 175p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756443/JAW.

The molecular structure of uranium complexes is determined by X-ray diffraction for monocrystals, paramagnetic NMR for solutions and EXAFS for both. The last method can be applied for any oxidation degree of uranium. Solubilization of uranyl and uranium IV hydroxides by cyclodextrins is evidenced and complexation is shown by NMR and polarography. The [222] cryptand diamine-N-oxide was synthesized and the structure of various compounds of this macrocycle is studied. Insertion of uranium III in 18-crown-16 is studied by EXAFS in the complex U/sub 3/ (BH/sub 4/)/sub 9/ (18-crown-6)/sub 2/. The structure of the uranium complex U(BH/sub 4/)/sub 2/ dicyclohexyl-(18-crown-6)BH/sub 2//sup +/UCl/sub 5/(BH/sub 4/)/sup 2-/ is determined by X-ray diffraction. NMR shows that 18-crown-6 and B isomer of dicyclohexyl 18-crown-6 stabilize the cation U(BH/sub 4/)/sub 2//sup +/ in dichloromethane and [222] cryptand stabilizes U(BH/sub 4/)/sub 3/ in nitromethane.

15529 (INIS-mf—11348, pp 113) **Synthesis and characterization of lanthanide complexes with the macrobicyclic ligand 222BB.** Ramirez, F.de M.; Solache Rios, M.; Campero, A. (Instituto Nacional de Investigaciones Nucleares, Mexico City; Universidad Autonoma Metropolitana, Mexico City. Div. de Ciencias Basicas y Ingenieria). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15530 **(INPE—4398) Alumina supported iridium catalysts - preparation.** Santos Cunha, D. dos; Cruz, G.M. da; Rodrigues, J.A.R.; Freitas, A.G. de. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Sep 1987. 15p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705535/JAW.

This report describes the method employed in the preparation of alumina supported iridium catalysts, with metal contents between 30 and 40%, that will be used for hydrazine monopropellant decomposition.

15531 **(LBL—26132) Preparation and characterization of novel boron nitride intercalation compounds and Ag (III) fluorocomplexes.** Mayorga, S.G. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 113p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007129/JAW.

This research exploits the extraordinarily stable anions, SO_3F/sup {minus}/ and MF_6/sup {minus}/ (M = As, Sb) to stabilize cationic entities, such as (BN)/sub x/$^+$, O_2^+, and AgF_2^+ in the preparation of novel materials. The metal pentafluoride in combination with fluorine is a powerfully oxidizing system producing AsF_6/sup {minus}/ and SbF_6/sup {minus}/ or the polymeric anion Sb/sub n/F/sub 5n+1//sup {minus}/ which stabilize the cationic species. When hexagonal boron nitride is exposed to $S_2O_6F_2$ it rapidly forms a deep blue intercalation compound of the composition $(BN)_9SO_3F$. Further treatment of $(BN)_9SO_3F$ with AsF_5 alone or AsF_5/F_2 has resulted in the formation of new intercalation compounds formulated as (BN)/sub >9/AsF_5SO_3F and (BN)/sub >4.8/AsF_6, respectively. A mixture of SbF_5/F_2 will spontaneously

oxidize boron nitride producing a boron nitride fluoroantimonate compound, (BN)/sub x/(SbF_5)/sub n/F. Attempts to intercalate BN with some very powerfully oxidizing noble metal hexafluorides, MF_6 (M = Os, Ir, Pt), have resulted in the oxidation of BN to BF_3 and N_2 with the corresponding reduction of MF_6 to lower metal fluorides or the metal. These materials appear to be neither thermodynamically nor kinetically stable. Evidence is given for the reversible dissolution of dioxygenyl salts in thoroughly dried HF. Also, evidence is presented for the existence of the silver (III) fluorocation, AgF_2^+. 98 refs., 9 figs., 10 tabs.

15532 **(MLM—3559) Mound activities in chemical and physical research: January--June 1988.** (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 22 Dec 1988. Contract AC04-88DP43495. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007304/JAW.

Research in separation processes and chromium research are briefly described. Separation factors of NH_2D/NH_3 and $^{15}NH_3/NH_3$ were measured in a short liquid phase thermal diffusion column. Thermal diffusion factors were measured for the pairs benzene/benzene-$^{13}C_6$ and benzene/benzene-d_6. The results, in combination with those of earlier experiments with deuterated benzenes, permitted independent evaluation of the effects of mass, rotational inertia, and load on the thermal diffusion factor. The campaign to separate ^{30}Si by thermal diffusion of tetramethysilane in a 15-column cascade was completed. Precise separation coefficients were determined for calcium chemical exchange with Chelex-100, and iminodiacetate chelating anion, and polymer-bound cryptand Kryptofix{reg←sign} 222B Polymer. Chromatography columns were used to enrich the heavy calcium isotopes. The separation coefficients for the $^{40}Ca/^{44}Ca$ isotope pair were determined. In the area of chromium research, it is found that chromium (II) tricyanomethanide, a stable compound of divalent chromium, may be useful as a source of the essential trace metal chromium. 10 refs., 10 figs., 5 tabs.

15533 **(NSS/R—120) Experimental measurements of the solubility of technetium under near-field conditions.** Pilkington, N.J.; Wilkins, J.D. (UKAEA Harwell Lab. Chemistry Div.). (United Kingdom Nirex, Ltd., Harwell). May 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705580/JAW.

The solubility of technetium in contact with hydrated technetium dioxide under near-field conditions has been measured experimentally. The values obtained were changed little by a change in pH or in the filtration method used. The presence of organic degradation products increased slightly the solution concentration of technetium.

15534 **(SAND—88-0668C) The use of x-ray microanalysis in the study of diffusion.** Goldstein, J.I.; Notis, M.R.; Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 9 Oct 1988. Contract AC04-76DP00789. 40p. (CONF-8809201—2). NTIS, PC A03 - OSTI. Order Number DE89003402/JAW.

From American Institute of Mechanical Engineers meeting; Chicago, IL, USA (25 Sep 1988).

This paper reviews the use of electron probe microanalysis, scanning electron microscopy and analytical electron microscopy in the measurement of compositional data obtained from diffusion couples. Methods to obtain x-ray spatial resolution as low as 1nm with the AEM are described. In addition, techniques for improving the detection and for increasing the accuracy of compositional analyses are summarized. Sample preparation techniques for AEM are also discussed. Examples of the use of the above methods for materials problems such as Cu-Sn-Pb-Au solders, Ni-Cr-Al coatings, N diffusion in Fe and Ni-Nb diffusion couples are given. 55 refs., 20 figs.

15535 **(SAND—88-0907C) Studies of diffusion by energetic ion analysis techniques.** Borders, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 25p. (CONF-8809201—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005206/JAW.

From American Institute of Mechanical Engineers meeting; Chicago, IL, USA (25 Sep 1988).

Diffusion measurements are generally accomplished using destructive analytical methods such as radio-tracer depth profiling or electron microprobe analysis of cross-sectioned samples. Energetic ion analysis methods offer several desirable alternatives including non-destructive depth profiling of atomic composition and the ability to measure very small diffusion distances (10-30 nm). The general principles of energetic ion analysis methods are outlined and illustrated with examples of their use in the study of diffusion. 24 refs., 13 figs.

15536 **Photoion—photoelectron coincidence study of Ar/sub n/ (n = 2—4).** Norwood, K.; Guo, J.; Ng, C.Y. (Ames Laboratory, U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **90**: No. 6, 2995-3003(15 Mar 1989).

Photoion—photoelectron coincidence (PIPECO) spectra for Ar^+/sub n/ (n = 2—4) in the wavelength region of 750—875 A have been measured at different nozzle stagnation pressures. The ionization energies (IE) for the ground Ar^+_2[I(1/2)/sub u/] and Ar^+_3[I(1/2)/sub u/] states are determined to be 14.518 +- 0.017 eV (854 +- 1 A) and 14.350 +- 0.033 eV (864 +- 2 A), in agreement with the findings of previous photoionization experiments. The IE for Ar^+_2[II(1/2)/sub u/] is found to be approx. <15.83 eV (783 A). The observation of the Ar^+_2[II(1/2)/sub u/] PIPECO band supports the interpretation that Ar^+_2[II(1/2)/sub u/] is metastable with a lifetime longer than 47 μs, a value in accord with the calculated radiative lifetime of 90.9 μs for the II(1/2)/sub u/ →I(1/2)/sub g/ transition. The PIPECO spectrum for Ar^+_2 is dominated by autoionization structure similar to that resolved in the photoionization efficiency spectrum for Ar^+_2, indicating that a significant fraction of electrons produced by these autoionizing states are slow electrons with near-zero kinetic energies. Evidence is found that metastable Ar^+_3 and Ar^+_4 ions formed by photoionization of Ar_3 and Ar_4 at energies above the Ar^+_2[I(1/2)/sub u/]+Ar($^1S_0$) and Ar^+_3[I(1/2)/sub u/]+Ar($^1S_0$) dissociation limits may live longer than 58 and 66 μs, respectively. We suggest that the formation of Ar^+_3 in metastable electronic states may be responsible for the long dissociation lifetimes of Ar^+_3 observed in this experiment.

15537 **Resonant processes above the carbon 1s ionization threshold in benzene and ethylene.** Piancastelli, M.N.; Ferrett, T.A.; Lindle, D.W.; Medhurst, L.J.; Heimann, P.A.; Liu, S.H.; Shirley, D.A. (Department of Chemistry, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **90**: No. 6, 3004-3009(15 Mar 1989).

Resonant photoemission has been studied above the carbon 1s ionization thresholds in gas-phase benzene and ethylene. The experimental data for both molecules include relative partial cross section and asymmetry-parameter measurements for the C 1s main line and asymmetry-parameter measurements for one C 1s shake-up satellite in each system. Resonances above the C K edge have been analyzed on the basis of their decay to either the C 1s main line or valence-hole states, and have been tentatively assigned as either shape resonances or doubly excited states according to their observed one-electron or many-electron decay, respectively. The importance of determining the resonant behavior of all available photoemission channels in the proximity of a resonance is thus illustrated.

15538 **Test of the accuracy of small-curvature and minimum-energy reference paths for parametrizing the search for least-action tunneling paths: (H,D)+H'Br→(H,D)Br+H'.** Lynch, G.C.; Truhlar, D.G.; Garrett, B.C. (Department of Chemistry and Supercomputer Institute, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* **90**: No. 6, 3102-3109(15 Mar 1989).

The least-action semiclassical algorithm for multidimensional tunneling probabilities [B. C. Garrett and D. G. Truhlar, J. Chem. Phys. 79, 4931 (1983)] has usually been employed by interpolating tunneling paths between two limits, a least-motion limit appropriate for large reaction-path curvature and a minimum-energy limit appropriate for small reaction-path curvature. In the present study we test whether, when the reaction-path curvature is small, more accu-

rate results might be obtained by using a general small-curvature reference path. Least-action algorithms with both types of reference paths are compared to each other, to five other semiclassical approximations, and to accurate quantal dynamical rate constants for one three-dimensional and two collinear reactions with the mass combination L-script+H-script L-script'→L-script H-script+L-script' where L-script and L-script' denote light atoms (H or D) and H-script denotes a heavy atom (Br). We find, perhaps surprisingly, that the usual least-action method works best. This is encouraging because the minimum-energy reference is easier than the small-curvature reference to extend to polyatomic reactions.

15539 **Global potential-energy surfaces for H_2Cl.** Schwenke, D.W.; Tucker, S.C.; Steckler, R.; Brown, F.B.; Lynch, G.C.; Truhlar, D.G.; Garrett, B.C. (Department of Chemistry and Supercomputer Institute, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* **90**: No. 6, 3110-3120(15 Mar 1989).

We present two new analytic potential-energy surfaces suitable for studying the competition between the abstraction reaction H+DCl→HD+Cl and the exchange reaction H+DCl→HCl+D. In the abstraction channel the surfaces are only slightly different from the Stern—Persky—Klein GSW surface, but the exchange barrier on both surfaces is raised by inclusion of a three-center term fitted to ab initio extended-basis-set multireference configuration interaction calculations with scaled external correlation. The two surfaces differ significantly only for the steepness of H—Cl—H bend potential. The exchange and abstraction saddle points are characterized by harmonic analysis for H_2Cl, HDCl, and D_2Cl, and we also compute vibrationally adiabatic barrier heights including anharmonicity. We also report thermal rate constants and activation energies for both reactions mentioned above.

15540 **Fourier transform—electron spin resonance study of spin polarization generated by triplet- and radical-pair mechanisms in a photoinduced electron transfer reaction.** Plueschau, M.; Zahl, A.; Dinse, K.P.; van Willigen, H. (Department of Physics, University of Dortmund, 4600 Dortmund, Federal Republic of Germany). *Journal of Chemical Physics;* **90**: No. 6, 3153-3158(15 Mar 1989).

Fourier transform—electron spin resonance (FT—ESR) was utilized to measure the photoinduced charge transfer in the system Zn tetraphenylporphyrin/duroquinone with a time resolution of 10 ns. The separate observation of the intensity/time profile of different hyperfine lines in the spectrum, which was made possible by application of FT—ESR, enabled the independent determination of transient acceptor radical polarization originating from the triplet- and radical-pair mechanism. The observed temperature dependence and the absolute value of the electron transfer rate lead to the conclusion that the process is diffusion limited with no indication of an activation barrier.

15541 **Determination of the structure of mixed argon—xenon clusters using a finite-temperature, lattice-based Monte Carlo method.** Robertson, D.H.; Brown, F.B.; Navon, I.M. (Department of Chemistry and Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306). *Journal of Chemical Physics;* **90**: No. 6, 3221-3229(15 Mar 1989).

The energy-optimized structures of all mixed Ar—Xe clusters containing 7, 13, and 19 atoms have been determined using a finite-temperature, lattice-based Monte Carlo procedure, which incorporates a highly efficient, memoryless, quasi-Newton-like conjugate gradient algorithm. This involves locating the global minima on the corresponding potential energy surfaces constructed from pairwise-additive Lennard-Jones potentials. For these systems, this optimization procedure has been found to be much more efficient than the more generally applicable simulated annealing method. Based on these energy-optimized structures, substitution sequences have been presented and discussed.

15542 **Observation of l-dependent rate constants for ion production in Rydberg electron transfer reactions.** Carman H.S. Jr.; Klots, C.E.; Compton, R.N. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6125). *Journal of Chemical Physics;* **90**: No. 5, 2580-2584(1 Mar 1989).

Relative rate constants for negative ion production have been measured for the Rydberg electron transfer reactions $Cs^{**}(ns,np,nd) + SF_6 \rightarrow Cs^+ + SF^-_6$ and $Cs^{**}(ns,np,nd) + CCl_4 \rightarrow Cs^+ + Cl^- + CCl_3$. We find that rate constant for production of Cl^- from CCl_4 are dependent upon the angular momentum of the Rydberg electron, with k/sub n//sub d/>k/sub n//sub s/ for values of n as large as 40. Preliminary measurements for potassium (ns,nd) Rydberg atoms show that the l dependence for K is much smaller than that for Cs. These results are inconsistent with the "free electron model" used to describe these reactions. It is suggested that the observed l dependence is related to postattachment interactions with the Rydberg atom core which affect the survival of the Cl^- ions.

15543 **Use of the discrete variable representation in the quantum dynamics by a wave packet propagation: Predissociation of $NaI(^1u^+_0) \rightarrow NaI(0^+) \rightarrow Na(^2S)+I(^2P)$.** Choi, S.E.; Light, J.C. (The Department of Chemistry and the James Franck Institute, The University of Chicago, Chicago, Illinois 60637). *Journal of Chemical Physics;* **90**: No. 5, 2593-2604(1 Mar 1989).

Using the Gauss—Chebyshev discrete variable representation (DVR), the dissociative quantum dynamics for a wave packet evolving under the influence of the Hamiltonian for two interacting diabatic states of a diatomic molecule is calculated. The split time evolution operator method is used to obtain the solutions to the time-dependent Schroedinger equation. A specific example of the numerical calculation is shown for the predissociation process of $NaI \rightarrow Na(^2S)+I(^2P)$ from its first excited electronic state (0^+). The numerical results are compared with the experimental observations from the femtosecond laser photofragmentation, recently reported by Zewail and co-workers.

15544 **Variation with temperature of the electron attachment to SO_2F_2.** Datskos, P.G.; Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6122). *Journal of Chemical Physics;* **90**: No. 5, 2626-2630(1 Mar 1989).

The total electron attachment rate constant k/sub a/(<ϵ>,T) for SO_2F_2 has been measured, in a buffer gas of N_2, as a function of the mean electron energy <ϵ> (0.046—0.911 eV) and temperature T (300—700 K) using an electron swarm technique. From the measured k/sub a/(<ϵ>,T), the total electron attachment cross sections σ/sub a/(ϵ,T) were determined. At 300 K the σ/sub a/(ϵ,T) exhibits a maximum at ~0.22 eV which is due to dissociative electron attachment and an increase below ~0.1 eV which is due to the formation of parent negative ions $SO_2F^-_2$ at near zero energy. At T = 400 K, σ/sub a/(ϵ,T) has only one main peak at ~0.13 eV which is due only to dissociative electron attachment reflecting the depletion of the parent anions and the prevalence of the fragment negative ions as T increases. The main peak of σ/sub a/(ϵ,T) shifts to lower electron energies with increasing T so that at 700 K the peak is located at ~0.03 eV. The value, σ/sub d//sub a/(ϵ/sub max/), of the total electron attachment cross section at the peak energy ϵ/sub max/ increases by a factor of ~32 as T increases from 300 to 700 K.

15545 **Theoretical study of the energy of hypofluorous acid, HOF.** Pople, J.A.; Curtiss, L.A. (Chemistry Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Journal of Chemical Physics;* **90**: No. 5, 2833-2833(1 Mar 1989).

An ab initio molecular orbital study of the dissociation energy of HOF based on the newly developed G1 method is presented. The results indicate that the value of ΔH/sup circle-open//sub f/$_0$ of gaseous HOF derived by Berkowitz, Appelman, and Chupka should be reexamined and that the best experimentally de-

rived value of ΔH/sup circle-open//sub f/₀ of HOF is -19.9 kcal/mol, corresponding to a dissociation energy D_0(HO—F) of 47.5 kcal/mol.

15546 **Theory of ortho-para conversion in hydrogen adsorbed on metal and paramagnetic surfaces at low temperatures.** Yucel, S. (Department of Physics, Syracuse University, Syracuse, New York 13244). *Physical Review [Section] B: Condensed Matter;* **39**: No. 5, 3104-3115(15 Feb 1989).

In order to explain the experimental results on Cu(100), Ag(111), Ag thin films, graphite, and H_2 bubbles in Cu, the ortho-para conversion rates of H_2 and D_2 adsorbed on metal and paramagnetic surfaces at low temperatures have been considered. The conversion rates due to magnetic dipole-dipole, Fermi contact, and spin-orbit interaction between the conduction electrons, and nuclear spins of H_2 (D_2) are calculated to elucidate the role of the metal surface. Although the rates on clean metal surfaces are found to be too slow to account for the observed rates on Ag, they may explain the catalytic conversion on H_2 bubble surfaces at 1.3 K. Additionally, effects of impurities and defects on the surface are investigated by calculating the conversion rate in two-dimensional solid D_2 (H_2) by emission of one (two) phonon(s). Fast conversion rates observed on Ag and graphite surfaces as well as on the surfaces of H_2 bubbles may be accounted for by paramagnetic impurities or defects. On Grafoil, both in ($\sqrt{3}$ x $\sqrt{3}$)R30° commensurate and incommensurate solid phase, a temperature-independent conversion rate is predicted if the mobility of the molecules is high enough to prevent concentration gradients.

15547 **Liquid metal ion source and alloy.** Clark, W.M. Jr.; Utlaut, M.W.; Storms, E.K.; Behrens, R.G.; Szklarz, E.G.; Swanson, L.W.; Santandrea, R.P. (to Hughes Aircraft Co., Los Angeles, CA Oregon Graduate Center, Beaverton, OR and Dept. of Energy, Washington, DC). US Patent 4,775,818. 4 Oct 1988. Filed date 14 Apr 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A liquid metal ion source is described comprising: emission means for emitting positively charged ions of an elemental chemical species; and source means for supplying the species to be emitted to the emission means, the species being supplied in a congruently vaporizing non-eutectic alloy of the elemental chemical species and at least one other element.

15548 **Solar thermal, decomposition kinetics of zinc sulfate.** Tabatabaie-Raissi, A.; Narayan, R.; Mok, W.S.L.; Antal, M.J. Jr. (Natural Resources Research Institute, Univ. of Minnesota, Duluth, MN (US));. pp v of Solar engineering - 1988. Murphy, L.M.; Mancini, T.R. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880457—).

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

Solar thermal decomposition of zinc sulfate has been proposed as a preferred step in thermochemical water-splitting cycles for the production of hydrogen. In order to identify and/or verify the existence of solar unique effects involving high temperature/high heating rate solid phase decompositions, the reaction mechanisms and corresponding values of the kinetic parameters are determined in this paper. These values are then compared to those from lower temperature and lower heating rate studies. The authors also present the applications of a newly fabricated thermogravimetric analyzer system (Fast TGA). This system was used to study the decomposition of anhydrous zinc sulfate under prevailing conditions similar to those within a concentrating solar furnace. The calibration and characterization of the instrument for sample temperature and weight change measurements are explained in detail. The behavior of the system at temperatures (exceeding 1400 K) and heating rates in excess of 2 K/s in a radiant flux environment is discussed. The kinetic parameters for the decomposition of zinc sulfate were determined from the thermogravimetric data using a nonlinear least squares, NLS, optimization algorithm.

15549 **The structural, catalytic, and electronic properties of monolayer metallic films.** Goodman, D.W. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The present studies are part of a continuing effort to identify those properties of bimetallic systems which can be related to their superior catalytic properties. A pivotal question to be addressed of bimetallic systems (and of surface impurities in general) is the relative importance of ensemble (steric or local) versus electronic (nonlocal or extended) effects in the modification of catalytic properties. A complete understanding of surface impurity effects (including alloying) in catalysis will likely include components of both electronic and ensemble effects, the relative importance of each to be assessed for a given reaction and reaction conditions. An emphasis of the authors' research has been to address the importance of these two effects regarding the influence of alloying and surface additives on surface reactions.

15550 **In situ Raman spectroscopy of oxidation and reduction of high T superconducting materials at elevated temperatures.** Hamilton, J.C.; McCarty, K.F. (Sandia National Labs., Livermore, CA (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The superconducting transition temperature of the YBa/sub 2/CuO/sub 7-x/ system is critically dependent on the oxygen stoichiometry. Virtually all methods of preparation of thin film or bulk superconducting materials involve a final processing step at about 500 C in oxygen-containing gas which allows the oxygen stoichiometry associated with superconducting behavior to be established. The crystal structure of the superconducting phase is orthorhombic. For lower oxygen contents, a tetragonal phase is formed which does not demonstrate superconductivity at any temperature. In thin film processing, it is important to perform the anneal as rapidly as possible to add oxygen and form the orthorhombic phase while limiting diffusion of impurities from the substrate. The authors report here the use of Raman spectroscopy to determine the phases present during annealing in oxygen and argon at temperatures from 400 to 800 C. The depth probed by Raman spectroscopy is determined by the optical absorption coefficient of the sample for the exciting laser wavelength. For these highly opaque ceramics the probe depth is probably less than 1000A. This technique should be particularly useful for film superconductor processing because of its sensitivity (phase identification of 200A thick films is possible and applicability in ambient environments.

15551 **Distribution of chromium species in aluminum oxide layers.** Isaacs, H.S.; Heald, S.M.; Davenport, A.J.; Chen, H.; Thompson, G.E. (Div. of Materials Science, Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

During the growth of barrier-layer anodic oxide films the characteristic element from anions in the electrolyte is found to be incorporated in the oxide to different degrees. In the oxide layer it may migrate inward or outward or remain immobile as is the case for phosphorous, molybdenum and tungsten or arsenic respectively. The effective mobility depends on how the anion is incorporated within the oxide and on subsequent changes brought about by the high electric fields in the layer during growth. For example, when anodizing in a chromate solution, chromium could be electromigrate inward as an anion or outward as either a Cr(VI) or Cr(III) cation. The distribution of the incorporated element has been studied using electron transmission analytical techniques on ultramicrotomed film sections, Rutherford backscattering, sputtering second-

ary ion mass spectroscopy and Auger spectroscopy. X-ray photoelectron spectroscopy gives information on the chemical states of the characteristic element in the oxide but the measurements can be complicated by the required high vacuum and by sputtering for depth analysis.

15552 **Transition between bubbling and turbulent fluidization at elevated pressure.** Yang, W.C.; Chitester, D.C. New York, NY; American Institute of Chemical Engineers (1987). 30p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 150L.

Flow regime transition data were obtained from a two-dimensional Plexiglas cold model operated at pressures up to 6,464 kPa. Data on transition between bubbling and turbulent fluidization using bed materials of glass and coal of different particle size distributions are reported here. A general correlation was developed for the two-dimensional bubbling-turbulent transition, taking into account the existing literature data as well.

15553 **Drop formation from an orifice in an electric field.** Byers, C.H.; Perona, J.J. New York, NY; American Institute of Chemical Engineers (1987). 23p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 1F.

The use of an electric field to control the formation of small drops at an orifice in a circular disk was investigated. In this study, water drops were formed in a pure cyclohexane continuous phase, in the pre-jetting regime using four different orifice diameters. Because of the application of high potentials (up to 1000 V/cm) and because the orifice plate produced a nonuniform field, drop volumes varied to as little as 20 times smaller than the drop volume for a zero-field case. The drops were ellipsoidal in shape, and droplet eccentricity increased dramatically with field intensity. A mathematical model was developed, based on the potential field between a disk (the orifice plate) and an infinite plate (the grounded screen). The electric force on the drop was calculated from the field intensity at discrete points around the periphery. Values for predicted drop volumes using this model and for experimental drop volumes agreed very well.

15554 **Vibrational control of an exothermic CSTR.** Rigopoulos, K.; Shu, X.; Cinar, A. New York, NY; American Institute of Chemical Engineers (1987). 19p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 20C.

Interaction between various vibrating inputs may result in significant modifications in the behavior of a vibrationally controlled system. Forced oscillations in the input flow rate and input concentrations of an exothermic CSTR enable the stabilized operation of the CSTR in the unstable steady state. Reactor temperature oscillations under vibrational control are similar to the oscillations resulting from PI feedback or nonlinear (push-pull) feedback control and under some operating conditions the oscillation amplitude is significantly lower. Theoretical and experimental studies illustrate the effects of forcing frequency and phase shift on reactor behavior.

15555 **Bubble size and gas-liquid interfacial area measurements using molten paraffin waxes in bubble columns.** Bukur, D.B.; Patel, S.A.; Daly, J.G.; Raphael, M.L. New York, NY; American Institute of Chemical Engineers (1987). 34p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 24G.

Experiments were conducted in 0.05 m ID and 0.23 m ID by 3 m tall bubble columns with different types of molten waxes as the liquid medium and nitrogen as the gas, under processing conditions typical or Fischer-Tropsch synthesis over iron catalysts (i.e. gas velocities up to 0.15 m s, and temperatures between 200 and 270°C) to estimate gas liquid interfacial area from measured values of average gas hold-up and Sauter mean bubble diameter. The gas hold-up was estimated from visual observations of the expanded and static liquid heights, and the Sauter was estimated from bubble size measurements obtained by photography and dynamic gas disengagement. The paraffin wax (FT-300) used in the authors' studies is noncoalescing and has a tendency to foam. The amount of foam is greater for runs conducted in the order of increasing gas velocities, than in runs with decreasing velocities. Thus, two values of hold-up are possible and the start-up procedure determines which one will be attained. At higher gas velocities (> 0.05 m/s) the foam disappears and a transition to the slug flow, churn-turbulent regime takes place. Reactor waxes are coalescing in nature and do not produce foam. Despite similar hold-ups for the different waxes at higher gas velocities, the Sauters are significantly different and this is reflected in the specific gas-liquid interfacial areas, with larger values obtained with the paraffin wax compared to values with reactor waxes.

15556 **A 1-D model for highly sensitive tubular reactors.** Hagan, P.S.; Herskowitz, M.; Pirkle, J.C. New York, NY; American Institute of Chemical Engineers (1987). 23p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 35C.

The authors consider the steady state operation of wall-cooled, fixed-bed tubular reactors. In these reactors the temperature rise ΔT must normally be limited to small fractions of the adiabatic temperature rise $\Delta T/sub\ ad/$, both to avoid runaway and maintain product selectivity. Yet $\Delta T/\Delta T/sub\ ad/ << 1$ can only occur if $eta = t/sub\ dif//t/sub\ reac/ << 1$, where t/sub dif/ is the timescale on which heat escapes the reactor by "diffusing" to the cooled walls, and t/sub reac/ is the timescale over which the reaction occurs. So here the authors use asymptotic methods based on eta $<< 1$ to analyze the 2-d reactor equations, and find the radial concentration and temperature profiles to leading order in eta. The authors then obtain a 1-d model of the reactor by substituting these asymptotically correct profiles into the reactor equations and averaging over r. This model, the α-model, is identical to the standard (Beek and Singer) 1-d model, except that the reactor's overall heat transfer coefficient U is a decreasing function at the temperature rise ΔT. This occurs because as ΔT increases, the reaction becomes increasingly concentrated near $r=0$, causing a decreased heat transfer efficiency through the reactor's wall. By comparing it with numerical solutions of the original 2-d reactor equations, the authors find that the α-model simulates the 2-d equations very accurately, even for highly sensitive reactors operated near runaway. They also find that a runaway criterion derived from the α-model predicts the runaway transition of the original 2-d equations accurately, especially for highly sensitive reactors.

15557 **Design and minimum reflux calculations for multicomponent reactive distillation columns.** Barbosa, D.; Doherty, M.F. New York, NY; American Institute of Chemical Engineers (1987). 51p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 33A.

A new set of transformed composition variables is introduced to simplify the design equations for single-feed, multicomponent reactive distillation columns. Based on these equations, a general method of calculating minimum reflux ratios for reactive distillation columns is presented. The new composition variables are also used to derive simple relationships between the dependent design variables, which are not evident when the design equations are written in terms of mole fractions.

15558 A modeling study of vacuum sorption characteristics of carbon dioxide on 4A zeolite molecular sieves. Prazniak, J.K.; Byers, C.H. New York, NY; American Institute of Chemical Engineers (1987). 33p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 99C.

A model is presented to describe the isothermal adsorption of carbon dioxide and of nitrogen on 4A zeolite molecular sieves under cryogenic conditions. Langmuir's adsorption isotherm is used to represent equilibrium concentrations at the gas-sorbent interface. Numerical solution of the partial differential model equations is accomplished using orthogonal collocation in conjunction with an ordinary differential equation integrator. Experimental results are compared with theoretical results obtained using the proposed model. Good agreement with experimental results for CO/sub 2/ cryosorption was obtained by increasing the Langmuir saturation constant to 20% greater than the value estimated in the previous study and by specifying an effective value for the mean pore radius of gas flow channels in the bed. The lack of agreement between theoretical and experimental results for N/sub 2/ cryosorption supports a conclusion reached earlier that the controlling diffusional resistance for N/sub 2/ cyrosorption is in the bed interstices and macropores.

15559 Nucleation and growth kinetics of zirconium hydroxide by precipitation with ammonium hydroxide. Carleson, T.E.; Chipman, N.A. New York, NY; American Institute of Chemical Engineers (1987). 23p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 103A.

The results of a study of the nucleation and growth kinetics of the precipitation of zirconium hydroxide from the reaction of hexafluorozirconate solution with ammonium hydroxide are reported. The McCabe linear growth rate model was used to correlate the results. The growth rate decreased with residence time and supersaturation for studies with 7 residence times (3.5 - 90 minutes and two supersaturation ratios (0.03 - 0.04, and 0.4). The nucleation rate increased with residence time and supersaturation. A negative kinetic order of nucleation was observed that may be due to the inhibition of particle growth by adsorption of reacting species on the crystal surfaces.

15560 Hydrolysis and condensation kinetics for liquid-phase tetraethylorthosilicate reactions in alkaline-alcohol solvents. Harris, M.T.; Byers, C.H.; Brunson, R.R. New York, NY; American Institute of Chemical Engineers (1987). 42p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 103D.

The hydrolysis and condensation kinetics for the Stober-Fink method of producing monodisperse silica particles have been studied by chemical analyses (i.e., gas chromatography and molybdate for determining monomeric silicic acid concentrations) and laser-light-scattering techniques. Studies have been conducted to determine the effects of temperature, reactant and catalyst concentrations, and solvent type (i.e., 1-propanol, 2-propanol, 1-butanol, 2-butanol, tert-butyl alcohol, and tert-amyl alcohol) on the rate of hydrolysis, rate of condensation, and particle growth kinetics. The effects of hydrogen bonding and steric hinderance of the solvent on the reaction kinetics are discussed. An important aspect of this research is the chemical evidence that monodisperse silica particles are produced by controlled homogeneous precipitation. This study is of fundamental importance for understanding the chemistry and physics of producing small particles that will be used as precursor materials for ceramics and support material for chromatographic packing.

15561 High-temperature sulfidation-regeneration of CuO-Al/sub 2/O/sub 3/ sorbents. Jothimurugesan, K.; Patrick, V.; Gavalas, G.R.; Flytzani-Stephanopoulos, M. New York, NY; American Institute of Chemical Engineers (1987). 50p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 114B.

Two types of experiments were used to study sulfidation-regeneration of highly porous CuO-Al/sub 2/O/sub 3/ sorbents. In TGA studies, sulfidation of reduced sorbents produced a high-temperature form of digenite (Cu/sub 9+x/S/sub 5/) as the major crystalline product. When a platinum pan was used in the TGA, significant sulfur chemisorption on alumina occurred. Sulfur chemisorption on alumina was eliminated by use of a quartz sample pan. A fraction of highly dispersed metallic copper (≦50 A) remained unsulfided in the presence of sulfur-free alumina. Upon exposure of these sorbents to a gas mixture of H/sub 2/S, H/sub 2/, H/sub 2/O, and N/sub 2/ in a packed bed microreactor at temperatures between 550°C and 800°C, the pre-breakthrough outlet H/sub 2/S levels were considerably lower than those predicted by the sulfidation equilibrium of metallic copper. Independent reduction experiments confirmed that alumina stabilizes CuO from complete reduction to Cu. With this mechanism at work, low pre-breakthrough H/sub 2/S levels are attributed to sulfidation reactions of copper at oxidation states of +1 or +2. The sulfided sorbents were completely regenerable in air/N/sub 2/ mixtures with no deterioration of subsequent sulfidation performance.

15562 Error analysis for the National Bureau of Standards 1016 mm guarded hot plate. Rennex, B.G. (U.S. Dept. of Commerce, National Bureau of Standards, National Engineering Lab., Center for Building Technology, Washington, DC (US));. pp v of Advances in foam aging: A topic in energy conservation. Volume I. Brandreth, D.A. Yorklyn, DE; Caissa Editions (1986).

This report is one of a series documenting NBS research and analysis efforts to support the Department of Energy/National Bureau of Standards' Measurements Program. The work reported in this document was performed cooperatively and supported by DOE/NBS Task Order A008 under Interagency Agreement No. DE-AI01-76PR06010.

15563 The synthesis of potentially mutagenic polycyclic aromatic thiophenes and their methyl derivatives via the Wadsworth-Emmons reaction followed by photocyclization. Castle, R.N.; Iwao, M.; Tominaga, Y.; Pratap, R.; Tedjamulia, M.; Lee, M.L. (Dept. of Chemistry, Univ. of South Florida, Tampa, FL (US));. pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

The characterization of polycyclic aromatic compounds in such complex mixtures as coal liquids and shale oils by capillary column gas chromatography-mass spectrometry has been reported. Recently, using these methods, a great many polycyclic sulfur heterocycles have been separated and identified from coal gasification tar, coal-liquids and shale oils. In order to distinguish unequivocally among the large numbers of isomeric polycyclic thiophenes of identical molecular weight, the authors have undertaken and completed the synthesis of forty-five different unsubstituted tri, tetra- and pentacyclic thiophenes using a variety of synthetic methods which produce the requisite compounds by unequivocal methods. Of the various synthetic approaches used, the Wadsworth-Emmons reaction followed by photocyclization has proven the most useful, thus in this communication, these latter two methods will be discussed.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 14837, 14843, 14844, 14944, 14947, 15148, 15202, 15203, 15205, 15209, 15210, 15212, 15213, 15549

15564 **(CONF-8809221—5) Continuing investigations on electrochemical preparation of LEU [low-enriched uranium] targets for ^{98}Mo production.** Marshall, S.L.; Redey, L.; Vissers, D.R.; Vandergrift, G.F.; Matos, J.E. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004203/JAW.

From International meeting on reduced enrichment for research and test reactors (RERTR); San Diego, CA, USA (18 Sep 1988).

Continuing investigations of uranium electrodeposition from molten salts, as a possible method for the preparation of low-enriched uranium targets for ^{99}Mo production, are described. Potential-pulse plating has been applied with two electrolytes: (1) a UCl_3-LiCl-KCl mixture close to the eutectic composition and (2) 4 w/o UF_4 in LiCl-KCl-LiF ternary eutectic. The widest range of operating conditions is provided by the second electrolyte at 504{degree}C. This electrolyte is economically attractive owing to its low uranium content. Dendrite-free, well-bonded uranium films have also been produced with bipolar current-pulse plating on substrates. Current densities sufficient to plate 6-mil coatings in 8 hours have been achieved without loss of coating uniformity or adhesion. This process was demonstrated on a cylindrical mock target that was approximately 1/3 the size of a commercial target. 8 refs., 4 figs.

15565 (INIS-mf—11348, pp 115) **UCl/sub 4/ = UCl/sub 3/ electrolytic cell.** Solorza, Omar; Quiroz F, H.; Ordonez R, E.; Fernandez, V.S. (Instituto Politecnico Nacional, Mexico City. Centro de Investigacion y de Estudios Avanzados; Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15566 **(QER—8202) Electrochemistry research in Quebec. Program of intervention.** (Quebec Ministere de l'Energie et des Resources, Quebec (Canada)). 1982. 50p. (In French). (CE—02181). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A study has been undertaken to recommend the establishment of an electrochemical research centre in Quebec. The centre is felt to be important for three fundamental reasons: the importance of increased research and development in those electrochemical techniques related to energy storage and conversion; the significant contributions of such research to industrial performance in Quebec in certain priority areas; and the providing of an opportunity to train researchers for the future. In the long term, the centre would concern itself with all aspects of electrochemical technology; short term efforts would be concentrated on hydrogen utilization, batteries, and electrometallurgy. The benefits for Quebec industry would be especially notable in the area of hydrogen technology; if the research effort is realized, Quebec could conserve its lead in the development of technology related to hydrogen production by electrolysis and in the related fields of transport, storage, liquefaction, and safety. The ready availability and low cost of hydroelectricity in Quebec favors the establishment of industries using large amounts of electric power, which could therefore benefit from, and be attracted to the province by, an electrochemical research centre. A solid base of electrtochemical expertise already exists in the province, and policies are outlined for utilizing Quebec's human resources in the centre. The Quebec government role in implementation of the centre is also described. 18 refs., 1 tab.

15567 **(UCRL—99931) Strategy of experimentation.** Dini, J.W. (Lawrence Livermore National Lab., CA (USA)). 9 Nov 1988. Contract W-7405-ENG-48. 25p. (CONF-890155—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003897/JAW.

From American Electroplates Societies Foundation (AESF) meeting on aerospace plating; Orlando, FL, USA (25 Jan 1989).

Optimizing the performance of a plating process need not involve extensive, tedious testing. The experimentation strategies described in this paper require relatively few test runs, yet they provide a simple three-dimensional picture that allows one to "see" the effects of the system variables over the entire operating range. A number of examples are included. 15 refs., 7 figs., 9 tabs.

15568 **Determination of the transfer coefficient using DC transient techniques coupled with all-numerical data-evaluation methods.** Nagy, Z. (Argonne National Lab., Divisions of Materials Science and Chemical Technology, Argonne, IL (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

The desired dc relaxation (transient) techniques were generally not satisfactory for the determination of the charge transfer coefficient (α) of an electrochemical reaction, especially for those cases when α may depend on the potential. To permit a simple determination or the kinetic parameters from the experimental relaxation curve, the data-evaluation methods were based on simple models containing many assumptions; one of these, often tacit, assumptions was the potential independence of α. Furthermore, most models were based on the linearized form of the Butler-Volmer equation, eliminating α, in effect, from the model.

4005 Photochemistry

15569 **(DOE/ER/13905—1) Photoinduced electron transfer in ordered polymers: Progress report, May 1, 1988--December 31, 1988.** Jones, G. II. (Boston Univ., MA (USA). Dept. of Chemistry). 31 Dec 1988. Contract FG02-88ER13905. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006986/JAW.

Long-range photoinduced electron transfer between potential electron donors and acceptors is of considerable current interest in terms of strategies for artificial photosynthesis and studies regarding the redox properties of proteins. Electron transfer over organized arrays of significant dimension (e.g., 10 nm) may also be important for molecule-based bistable switches or rectifiers. As part of a program of study of long range electron transfer involving biopolymers, we report early investigations of the interaction of the xanthene dye, eosin (EY), with synthetic peptides constructed of the amino acid residues, lysine (Lys), tryptophan (Trp), and tyrosine (Tyr). The principal interest in these systems has to do with the well ordered secondary structures (e.g., α-helices) adopted by peptide polymers and the capabilities for synthetic modification of peptide side chains and end groups with chromophores or electroactive substituents. Work which is completed or well underway includes synthesis of Trp homopolymer (20-25 Trp amino acid residues) with EY attached specifically at the N-terminus. Model compounds in which the xanthene dye is attached to one or two Trp residues have been prepared along with copolymers of Trp or Tyr and Lys with randomally labeled EY at Lys side chains. Photoinduced electron transfer between variously attached eosin pendants and co-bound Trp units has been studied using fluorescence quenching and laser flash photolysis methods. Also, as a model for events occurring for the synthetic peptides, electron transfer quenching of eosin singlet and triplet excited states by substituted phenols, representative of the pendant groups of Tyr residues has been investigated. The observation of ultra-long-lived contact radical ion pairs which result from the quenching an excited quinone molecule and the photolysis of quinone charge-transfer complexes constitute another theme of continuing research.

15570 **(UCRL—100040) Acoustoelasticity using longitudinal waves for residual stress evaluation.** Dike, J.J.; Johnson, G.C.; Flower, E.C. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 8p. (CONF-880760—10). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006154/JAW.

From Review of progress in quantitative nondestructive evaluation; La Jolla, CA, USA (31 Jul 1988).

Residual stresses play an important role in the behavior of structures during machining and under load. Knowledge of these residual stress states allows better and more efficient use of the structures, as well as more accurate predictions of their behavior. In this paper, a new method for nondestructively evaluating complete states of plane residual stress is presented. The basic analytical and experimental procedures are reviewed, and results of estimated residual stresses are compared with numerical predictions. Several methods are available for determining residual stresses. Nondestructive techniques include x-ray and neutron diffraction studies that measure residual strains through determination of crystal lattice spacing. Here we examine the application of a nondestructive technique called acoustoelasticity which employs ultrasonic waves in the evaluation of residual stress states. 9 refs., 3 figs.

15571 **Velocity-aligned Doppler spectroscopy.** Xu, Z.; Koplitz, B.; Wittig, C. (Department of Chemistry, University of Southern California, Los Angeles, California 90089-0482). *Journal of Chemical Physics;* **90**: No. 5, 2692-2702(1 Mar 1989).

The technique of velocity-aligned Doppler spectrosocopy (VADS) is presented and discussed. For photolysis/probe experiments with pulsed initiation, VADS can yield Doppler profiles for nascent photofragments that allow detailed center-of-mass (c.m.) kinetic energy distributions to be extracted. When compared with traditional forms of Doppler spectroscopy, the improvement in kinetic energy resolution is dramatic. Changes in the measured profiles are a consequence of spatial discrimination (i.e., focused and overlapping photolysis and probe beams) and delayed observation. These factors result in the selective detection of species whose velocities are aligned with the wave vector of the probe radiation k/ sub pr/, thus revealing the speed distribution along k/sub pr/ rather than the distribution of nascent velocity components projected upon this direction. Mathematical details of the procedure used to model VADS are given, and experimental illustrations for HI, H_2S, and NH_3 photodissociation are presented. In these examples, pulsed photodissociation produces H atoms that are detected by sequential two-photon, two-frequency ionization via Lyman-α with a pulsed laser (121.6+364.7 nm), and measuring the Lyman-α Doppler profile as a function of probe delay reveals both internal and c.m. kinetic energy distributions for the photofragments. Strengths and weaknesses of VADS as a tool for investigating photofragmentation phenomena are also discussed.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 15350, 15585, 16038, 16086, 16094, 16095, 16102, 16106, 16107, 16111

15572 **(CEA-CONF—9391) Effect of electrostatic interactions on electron-transfer reactions.** Hickel, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 10p. (CONF-8709247—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756405/JAW.

From 42. international meeting on chemical reactivity in liquids-fundamental aspects; Paris, France (7 Sep 1987).

Fast reactions of electron transfer are studied by pulsed radiolysis. By this technique radicals and ionic radicals with high redox potentials are created homogeneously in the solution in about 10/ sup -8/ second. For solvated electron effect of electrostatic interaction on kinetics of reactions limited by diffusion is obtained with a good approximation by the Debye equation when ion mobility is known. Deviation from the theory occurs in ion pair formation, which is evidenced experimentally in reactions between anions when cations are complexed by a cryptate. Slow reactions (k < 10/sup 8/ M/sup -1/ s/sup -1/) are more sensitive to electrostatic interactions than reactions limited by diffusion. When there is no ion pair formation the velocity constant depends upon dielectric constant of the solvent and reaction distance. 17 refs.

15573 **(CEA-tr—2307) Method for the calculation of degradation and cross-linking parameters of polymers exposed to ionizing radiations.** Bednar, B.; Bernauer, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1988. 6p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756667/JAW.

A minimization process using integral and differential equation system is developed. Simulated experimental data are used for testing the sensitivity of the method for individual parameters.

15574 (INIS-mf—11348, pp 70,72) **Positronium formation : Interrelation with radiation chemistry.** Ito, Yasuo. (Tokyo Univ. (Japan). Research Center for Nuclear Science and Technology). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15575 (INIS-mf—11348, pp 33) **Effect of radiation on low pressure polyvinyl chloride (PVC).** Burillo, G.; Aguirre, M.E.; Takeshi, O.; Adem, E. (Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares; Universidad de Sonora (Mexico). Centro de Investigacion en Polimeros; Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Fisica). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15576 (INIS-mf—11348, pp 37) **Analysis of the gaseous radiolytic products formed from malonic and succinic acids and their corresponding nitriles.** Trevino, C.; Negron M, A.; Albarran, G.; Aguirre, M. (Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15577 (INIS-mf—11348, pp 39) **Gamma-radiation-induced reactions in CBr/sub 4/ + CCl/sub 4/ solutions.** Bertrand, C.A.; Collins, K.E. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Quimica). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15578 (INIS-mf—11348, pp 41) **Gamma-immobilized stationary phases for packed-column gas chromatography.** Basso, M.A.; Collins, K.E.; Collins, C.H. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Quimica). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15579 (INIS-mf—11348, pp 43) **Gamma-radiolysis of aqueous solutions of urea. Implications for chemical evolution.** Navarro G, R.; Honda, Y.; Negron M, A.; Chacon, E. (Maryland Univ., College Park (USA). Dept. of Chemistry; Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15580 (INIS-mf—11348, pp 47) **Methylmethacrylate-impregnated concrete polymerized with radiation.** Maldonado R, Arturo. (Universidad Autonoma de Zacatecas (Mexico). Facultad de Ingenieria). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15581 (INIS-mf—11348, pp 49) **Modification of polyethylene sheets with styrene-divinylbenzene copolymer using gamma radiation. Part III.** Dabek, R.; Braham P, E. (Universidad Autonoma de Coahuila (Mexico). Fac. de Ciencias Quimicas). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 14427, 14465, 14657, 14773, 15319, 15327, 15338, 15345, 15348, 15349, 15499, 15500, 15565, 15653, 15998, 16013, 16030, 16138, 16140, 16142, 16416

15582 **(AERE-R—12995) Study of actinide solubility limiting solid phases. A literature survey.** Thomason, H.P. (UKAEA Harwell Lab. Chemistry Div.). Jan 1988. 20p. H.M. Stationery Office, London, price Pound 8.00.

The literature has been surveyed for information on the identification and ageing of actinide solubility limiting solid phases. References include identification and ageing of actinide solids which do not necessarily relate to the control of solubility or the conditions found in the near-field of a repository. Methods which have been used to characterise actinide solids include X-ray diffraction, electron microscopy, Raman spectroscopy, X-ray photoelectron spectroscopy, electrochemistry and chemical analysis. The techniques most widely used are X-ray and electron diffraction. As well as characterisation, diffraction patterns have been used to monitor changes in the crystallinity of a solid with time. The ageing of alpha active actinide solids involves two conflicting processes. An amorphous actinide precipitate will, like most solids, become more crystalline with time. The recoil energy from the alpha decay of actinides will displace some of the atoms from their lattice sites and cause a decrease in crystallinity. The crystallinity of actinide solids affects solubility and is therefore an important parameter to study. Recommendations have been made for further environmental work.

15583 **(CEA-CONF—9409) Kinetics of the dissolution of plutonium dioxide in acidic media by Cr(II) reducing agent.** Machuron-Mandard, X.; Madic, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1988. 2p. (CONF-8804200—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756406/JAW.

From 18. actinide meeting; Paris, France (20 Apr 1988).

The study of the mechanism of the dissolution reaction of PuO/sub 2/, with Cr(II) in H/sub 2/SO/sub 4/ media has been undertaken. The reaction has been found to be Cr(II) independent for concentrations $>$ 0.05 M; for lower Cr(II) concentrations the dissolution rate decreases. The rate determining step is certainly an heterogeneous surface reaction as confirmed by the high value of the ARRHENIUS activation energy: (65 +- 5) kJ/mol/sup -1/. The reaction rate is first order with respect to the surface of the oxide. An empirical rate law is given. Application to the development of a chemical process using Cr(II) to decontaminate organic solid wastes containing PuO/sub 2/ is underway.

15584 **(IKMz—88-1) Institute of Nuclear Chemistry of Mainz University. Annual report 1987.** Weber, M. (comp.). (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie). Jun 1988. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756807/JAW.

Apart from the traditional topics of the institute's five working groups, i.e. rapid separation and exotic nuclei, nuclear structures, nuclear fission, heavy ion reactions, and ecology of radionuclides, the report includes papers investigating into the chemistry of the heaviest elements, papers on nuclear astrophysics, and brief contributions on applied radioactivity in anticipation of further and more detailed ones. Most of the studies are the result of national and international efforts in the sense of modern co-operative research. The report refers to the institute's collaboration with university teams and research institutes.

15585 **(INIS-mf—11348) 7th Nuclear Chemistry, Radiochemistry and Radiation Chemistry Symposium.** (Instituto Nacional de Investigaciones Nucleares, Mexico City; Zacatecas Univ. (Mexico). Centre Regional de Estudios Nucleares). Jul 1988. 143p. (In Spanish). (CONF-8807148—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW.

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

The conference heard a total of 58 papers of which 56 were incorporated in INIS, namely those dealing with radioimmunoassay, radiation shielding materials, and radiochemistry of technetium, iodine, uranium, rare earths and actinides. (MR).

15586 (INIS-mf—11348, pp 92) **Reduction of 99mTcO4 (-I) with stoichiometry quantities of Sn(II) in the presence and absence of light.** Goldberg L, J.; Marmolejo S, C. (Universidad Nacional Autonoma de Mexico, Edo. de Mexico. ENEP-Iztacala). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15587 (INIS-mf—11348, pp 93) **Light effect during the electrophoresis analysis of the reduction reaction of TcO4 (-I) with concentrate HCl.** Goldberg L, J.; Marmolejo S, C. (Universidad Nacional Autonoma de Mexico, Edo. de Mexico. ENEP-Iztacala). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15588 (INIS-mf—11348, pp 66) **Kinetic and thermodynamic aspects of trace-scale and single atom chemistry.** Guillaumont, R.; Adloff, J.P.; Peneloux, H. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Aix-Marseille-2 Univ., 13 - Marseille (France). Centre Universitaire de Luminy). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15589 (INIS-mf—11348, pp 88) **Hydration isomers of trace-level Cr(III).** Archundia, C.; Collins, K.E.; Collins, C.H. (Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares; Universidade Estadual de Campinas, SP (Brazil). Inst. de Quimica). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15590 (INIS-mf—11348, pp 109) **Protactinium.** Solache Rios, M. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15591 (INIS-mf—11348, pp 117) **Complexes of uranium IV with Schiff's bases.** Suarez R, R.A.; Solache Rios, M. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15592 (INIS-mf—11348, pp 21) **Preparation of a radiopharmaceutical for bone scanning.** Fucugauchi, M.E.; Urena N, F.; Lezama C, J. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15593 (INIS-mf—11348, pp 23) **Obtention of human serum albumin-99mTc and its radiochemical analysis.** Urena N, F.; Fucugauchi, M.E.; Lezama C, J. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15594 (INIS-mf—11348, pp 25) **Preparation of reagents for thyroid hormones radioimmunoassay.** Zambrano, F.; Lavalley, C.; Ferro, G.; Lezama C, J.; Samano, B. (Instituto Nacional de Investigaciones Nucleares, Mexico City; Universidad Autonoma del Estado de Mexico, Toluca. Escuela de Ciencias Quimicas). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15595 (INIS-mf—11348, pp 74) **Fluorine-18 : chemistry and applications.** Collins, C.H. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Quimica). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15596 (INIS-mf—11348, pp 76) **Purification of Mo-99 using chelex-100 ion exchange resin.** Sanchez, Victor; Millan, S.; Fucugauchi, L.A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15597 (INIS-mf—11348, pp 78) **Purification of molybdenum-99 by ion exchange chromatography.** Lopez, Rafael; Serrano, Juan; Fucugauchi, L.A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15598 (INIS-mf—11348, pp 80) **Synthesis of iodomethane labelled with I-131.** Cayetano C, J.; Ramirez, F.P.; Cortes, M.E. (Instituto Mexicano de Petroleo, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15599 (INIS-SU—64, pp 19-21) **Optimization of nuclide production by intermediate chemical reprocessing.** Zaritskaya, T.S.; Kiselev, G.V.; Rudik, A.P. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The technique for finding the optimum moment for intermediate chemical reprocessing of the irradiated target is described. It must provide for optimum purpose functional at the end of irradiation. 4 refs.; 1 tab.

15600 **(UCRL—97513-Rev.1) Tritium labeling of amino acids and peptides with liquid and solid tritium.** Peng, C.T.; Hua, R.L.; Souers, P.C.; Coronado, P.R. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 9p. (CONF-880505—21-Rev.1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006150/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Amino acids and peptides were labeled with liquid and solid tritium at 21 K and 9 K. At these low temperatures radiation degradation is minimal, and tritium incorporation increases with tritium concentration and exposure time. Ring saturation in L-phenyl-alanine does not occur. Peptide linkage in oligopeptides is stable toward tritium. Deiodination in 3-iodotyrosine and 3,5-diiodotyrosine occurs readily and proceeds in steps by losing one iodine atom at a time. Nickel and noble metal supported catalysts when used as supports for dispersion of the substrate promote tritium labeling at 21 K. Our study shows that both liquid and solid tritium are potentially useful agents for labeling peptides and proteins. 11 refs., 1 fig., 3 tabs.

15601 **Prepared for the thirtieth annual conference on bioassay analytical and environmental chemistry. Reliable analysis of high resolution gamma spectra.** Spitz, H.B.; Buschbom, R.; Rieksts, G.A.; Palmer, H.E. (Pacific Northwest Lab., PO Box 999, Richland, WA (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

A new method has been developed to reliably analyze pulse height-energy spectra obtained from measurements employing high resolution germanium detectors. The method employs a simple data transformation and smoothing function to calculate background and identify photopeaks and isotopic analysis. This technique is elegant in its simplicity because it avoids dependence upon complex spectrum deconvolution, stripping, or other least-square-fitting techniques which complicate the assessment of measurement reliability. A moving median was chosen for data smoothing because, unlike moving averages, medians are not dominated by extreme data points. Finally, peaks are identified whenever the difference between the background spectrum and the transformed spectrum exceeds a pre-determined number of standard deviations.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 15915

15602 **(CONF-8803184—1) Spectral analysis of a fourth-order singular differential operator arising in combustion.** Kaper, H.G.; Schultze, B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005841/JAW.

From International conference on theory and applications of differential equations; Columbus, OH, USA (21 Mar 1988).

Sivashinsky, Law, and Joulin (SLJ) present a mathematical model of stagnation-point flow combustion, where a premixed flame is stabilized in a combustible gas mixture flowing towards a

flat plate. The configuration is two-dimensional Cartesian, the relevant coordinates being x and y. The plate is located in the plane y = 0. The flow, which is symmetric around x = 0, is coming in from the positive y-direction. At any point (x,y) ϵ ({minus}∞, ∞) {times} (0, ∞), the flow velocity is given by the vector v = α(x, {minus}y), where $\alpha > 0$; α may be interpreted as a measure of the Reynolds number. Thus, as the flow approaches the plate, the streamlines bend outward away from the y-axis to become tangential at the plate. Under appropriate circumstances, a flame is stabilized parallel to the plate at some finite distance away from it. The flame is not necessarily planar; it may develop a spatial structure, which may evolve with time. Assuming that the position of the flame above the plate is described by a function y = {phi}(x,t), SLJ derived the following nonlinear fourth-order differential equation for {phi}: {phi}/sub t/ + 4{phi}/sub xxxx/ + {phi}/sub xx/ {minus} 1/2 ({phi}/sub x/)^2 + α(x{phi})/sub x/ = 0, {minus}∞ < x < ∞, t > 0. Our intention is to study the bifurcation of solutions for this equation from the trivial solution, using α as the bifurcation parameter. In this article we take the first step towards this goal and investigate the linearized equation {phi}/sub t/ + 4{phi}/sub xxxx/ + {phi}/sub xx/ + α(x{phi})/sub x/ = 0, {minus}∞ < x < ∞, t > 0. 11 refs.

15603 (DOE/ER/13897—9) The behavior of matter under nonequilibrium conditions: Fundamental aspects and applications: Progress report, April 15, 1988--April 14, 1989. Prigogine, I. (Texas Univ., Austin (USA). Center for Studies in Statistical Mechanics). Jan 1989. Contract FG05-88ER13897. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006617/JAW.

This paper discusses two topics: microscopic simulators and stochastic aspects of hydrodynamics and chemical instabilities; and microscopic meaning of irreversibility. 15 refs., 3 figs. (LSP)

15604 (N—89-12626, pp 393-438) **Aerojet TechSystems Company contribution to LOX/HC combustion and cooling technology.** Mercer, S.D.; Rousar, D.C. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The LOX/HC combustion and cooling data generated by the ATC programs of the past ten years were examined. In addition, ATC is currently conducting LOX/HC combustion technology programs that could have a significant impact on future engine development. The scope and preliminary results from these ongoing programs are presented. Finally, recommendations are made in terms of how future technology programs might be focused in order to have maximum benefit to the engine development program.

15605 (N—89-12626, pp 439-460) **Survey of LOX/hydrocarbon combustion and cooling.** Masters, A.I.; Visek, W.A.; Carroll, R.G. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Achieving high chamber pressure in oxygen/hydrocarbon booster engines will require different approaches to regenerative cooling, propellant injection, and combustion stabilization than engines of the past. Comparisons are made with substantiated oxygen/hydrogen combustion technology which has resulted in demonstrated high pressure capability. Means of applying this technology to hydrocarbon booster engines are discussed including: tripropellant cycles with hydrogen cooling, injection techniques for stable efficient combustion and use of acoustic liners as combustion stabilization devices.

15606 (N—89-12626, pp 461-473) **LOX/hydrocarbon combustion and cooling survey.** Cook, R.T.; Kirby, F.M. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Liquid oxygen (LOX) and hydrocarbon fuels (methane, propane, and RP-1) are very attractive for booster rocket engine applications because of their high bulk density and respectful performance. Vehicle payload capability is dependent on the attainable engine chamber pressure and the combustion efficiency of the selected propellant combination. Combustor design approaches are presented to attain maximum cooling, stability, combustion efficiency, and reusable life. Experimental combustion efficiency and hot-gas heat-transfer rates are discussed as related to combustor contour, thrust level scaling, and injector characteristics including mixture ratio biasing and film cooling. These experimental data are compared to theory, and empirical relationships are derived. Conventional cooling relationships and coking limits are presented for potential hydrocarbon fuels as derived from high heat flux and high pressure electrically heated tube experiments. Experimental results of combustor coolant liner materials compatibility with hydrocarbon fuels are discussed. The application of the results of these studies to future LOX/hydrocrabon engines are delineated.

15607 (N—89-12626, pp 529-548) **RP-1 and methane combustion and cooling experiments.** Bailey, C.R. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

A program was conducted to investigate ignition, combustion, and heat transfer characteristics of liquid oxygen and either RP-1 or methane fuel applicable to advanced booster engines. Experimental data for both staged combustion and gas generator cycles were obtained for methane. Testing using RP-1 was conducted in support of the gas generator cycle. A pressure-fed combustion system rated at 40,000 pounds thrust was used for all testing. Preburner and gas generator combustion data for both propellant combinations were obtained at pressures ranging from 1500 to 3100 psia and temperatures from 1600 to 2000 degrees Rankine. Main injector evaluations were accomplished primarily with test firings using a water-cooled calorimeter main combustion chamber. With this chamber, heat flux profiles and combustion performance were obtained at pressures to approximately 2200 psia. Several tests were conducted using a methane-cooled combustion chamber.

15608 (N—89-12626, pp 550-569) **Results of coaxial injector element testing.** Fisher, S.C. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The Turbine Drive Combustor Ignition and Durability Technology Program was created to develop technology that can be utilized to support the design and/or modification of reliable and durable future generation high performance oxygen/hydrogen rocket engine turbine drive combustors. The general objective was broken down into the two specific tasks of developing an analytical code for liquid rocket engine combustion systems and gathering part of the data required to anchor/verify this code and future codes. Hot fire tests were conducted to gain insight into the low mixture ratio ignition and combustion characteristics of coaxial elements as well as to collect data to support the code work. A portion of the recent hot fire testing conducted in this program is discussed. A total of 51 low pressure (100 to 200 psia) hot fire tests were run on a single Space Shuttle Main Engine oxidizer preburner element injector. The results of these tests are the main topic of this paper.

15609 (N—89-12626, pp 570-579) **Combustion modeling: Progress and projections.** Liang, P.Y. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

In 1985 Rocketdyne's ARICC combustion code entered operational phase from developmental phase with a successful engineering analysis of the Space Shuttle Main Engine (SSME) preburner injector element flows. The cases studied correspond to two design geometries and two engine operation conditions. Based on this experience, a much better understanding of the unique chal-

lenges of combustion modeling for multiphase flows and of the weakest links in the physical model is obtained. This presentation will discuss the nature of combustion model development and highlight the results of the injector study, especially the qualitative features of the problem that pertains to the choice of the numerical methodology. Numerical issues encountered that are peculiar to the simulation of combustion flows will be briefly discussed. Finally, the plan for future refinement of ARICC and its subcomponents into a reliable combustion model will be outlined.

15610 **Theoretical characterization of the minimum energy path for hydrogen atom addition to N_2: Implications for the unimolecular lifetime of HN_2.** Walch, S.P.; Duchovic, R.J.; Rohlfing, C.M. (ELORET Institute, Sunnyvale, California 94087). *Journal of Chemical Physics;* **90**: No. 6, 3230-3240(15 Mar 1989).

The minimum energy path (MEP) for the addition of a hydrogen atom to N_2 is characterized in CASSCF/externally contracted CI calculations using a [4s3p2d1f/3s2p1d] ANO basis set, with additional single point calculations at the stationary points of the potential energy surface using a [5s4p3d2f/4s3p2s] ANO basis set. These calculations represent the most extensive set of ab initio calculations on HN_2 completed to date, yielding a zero-point corrected barrier for HN_2 dissociation of $\approx$8.5 kcal mol^{-1}. The lifetime of the HN_2 species is estimated from the calculated geometries and energetics using both conventional transition state theory and a method which utilizes an Eckart barrier to compute one-dimensional quantum mechanical tunneling effects. This study concludes that the lifetime of the HN_2 species is very short, greatly limiting its role in combustion processes.

15611 **Scalar dissipation measurements in the developing region of a jet.** Namazian, M.; Schefer, R.W.; Kelly, J. (Combustion Research Facility, Sandia National Labs., Livermore, CA (US));. *Combustion and Flame;* **74**: No. 2, 147-160(Nov 1988).

Instantaneous planar images of CH/sub 4/ mass fraction in the developing region ($x/d \leqq 17$) of an isothermal jet were used to calculate instantaneous, mean, root mean square (rms), probability density functions (PDFs), and correlations of scalar dissipation and a scalar. The mass fraction images were derived from CH/sub 4/ concentrations obtained by simultaneously recording Raman-scattered light with two cameras oriented perpendicular to a thin sheet of laser light passed through the axis of the jet. Using two cameras enhanced the dynamic range by a factor of ten over a single-camera system and allowed concentration measurements down to a mass fraction of 0.003. Axial and radial components of the scalar dissipation were determined and, by assuming isotropy in the radial and azimuthal directions, total dissipation statistics were obtained. The results were used to evaluate modeling assumptions. The radial and axial dissipation components were found to be strongly nonisotropic in the mixing layer at $x/d \leqq 13$, but isotropic further downstream. At all locations along the centerline the dissipation was isotropic. The scalar and dissipation were found to be highly correlated in the mixing layer but uncorrelated on the jet axis. The PDF of dissipation on the axis, off axis, and at the stoichiometric surface were all found to be lognormally distributed. This property was used to collapse all of the PDFs onto one plot. The parameters that define the single plot, lognormal PDF mean, and standard deviation are reported. Instantaneous dissipation levels measured at the expected flame liftoff height were found to be consistent with flame extinction limits extrapolated from laminar opposed jet data. For the single condition measured, this data supports the hypothesis that excessive dissipation can extinguish flames in the developing region of jets.

15612 **Turbulent nonpremixed flames of methane near extinction.** Masri, A.R.; Bilger, R.W. (Dept. of Mechanical Engineering, The Univ. of Sydney (AU)); Dibble, R.W. (Combustion Research Facility, Sandia Nationalal Labs., Livermore, CA (US));. *Combustion and Flame;* **73**: No. 3, 261-286(Sep 1988).

Space- and time-resolved measurements of major species concentrations and temperature have been made using the Raman-Rayleigh scattering technique in the blue (visibly soot free) regions of turbulent nonpremixed flames of methane close to extinction. The data are presented in this paper in the form of single variate probability density functions (pdfs) for the mixture fraction, temperature, and the mass fractions of CH/sub 4/, O/sub 2/, H/sub 2/O, H/sub 2/, CO/sub 2/ and CO. Representative instantaneous scatter plots and joint pdfs are also shown. When the mixing rates are low, the data show mostly fully burnt mixtures indicating that the chemistry is relatively fast. As the flame approaches extinction, most local mixtures become either partially burn or simply mixed. The joint pdfs shown bimodality for mixture fractions less than —.1 and centered distributions for richer mixtures. When close to extinction, fully burnt pockets of fluid are still encountered and these may be responsible for keeping the flame alight. Questions relating to the local, instantaneous flame structure near extinction are discussed in light of existing theoretical models.

42 ENGINEERING

15613 **Coherence saturation for beams of energetic photons.** Csonka, P.L. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Physics Letters;* **54**: No. 10, 878-880(6 Mar 1989).

A new method is proposed to generate transversely coherent energetic photon beams. It does not rely on stimulated photon emission, therefore, is not subject to the same technological and cost limitations which affect bound-state x-ray lasers and free-electron x-ray lasers. The method leaves unchanged the photon source; it increases transverse coherence by dynamical optical means, i.e., using nonstationary optical elements. It is well suited to first-order interference experiments (e.g., x-ray holography) particularly with synchrotron radiation sources.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 14315, 14360, 14361, 14362, 14363, 14364, 14365, 14368, 14369, 14371, 14374, 14375, 14456, 14654, 14655, 14656, 14720, 14748, 15250, 15265, 15310, 15311, 15318, 15320, 15570, 15763, 15764, 15786, 15836, 15899, 16532, 16532, 16533, 16855, 16859

15614 **(AGA—9006595) Drop-Weight-Tear-Test Equipment Energy Calibration Program.** Eiber, R.J. (Battelle Columbus Div., OH (USA)). Oct 1988. 31p. American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209. Order Number TI89006595/JAW.

The Drop-Weight-Tear-Test (DWTT) energy absorption has not previously been considered as a measure of fracture toughness from this test. The DWTT was originally planned to define the fracture appearance transition temperature of line pipe. The test has been very successfully used for this purpose for the past 20 years. During this period of DWTT usage, the need for a toughness measurement to control ductile fracture propagation has seen the application of a Charpy shelf-energy in addition to a DWTT or Charpy shear area requirement in the specification of line-pipe properties. The purpose of exploring energy measurements in the DWTT is to determine if both fracture appearance and toughness can be obtained from a single test. To this end, a number of individual steel companies and gas-transmission companies have been examining the use of a DWTT energy measurement. Also, the Round Robin Program on the precracked drop-weight-tear test (DWTT) indicated that the energy measurements by the 12 participating laboratories had a coefficient of variation (standard deviation/average) that is about 30 percent larger than for the Charpy V-notch test. Also, the average energy variations between the various laboratories were quite large. This suggested that there was a need for calibrating the equipment used for energy measurements. It also suggested that equipment design may be a contributing factor. The objective of this program is to obtain reference steels that are uniform and of varying energy levels so that reference specimens can be supplied to a laboratory to assess the accuracy and precision of their DWTT energy measuring equipment. 7 figs., 5 tabs.

15615 (CEA-CONF—9432) Scheme for a fully superconducting electron injector. Jablonka, M.; Aune, B.; Magne, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de l'Accelerateur Lineaire). 1988. 4p. (CONF-880695—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756644/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

A scheme for a fully superconducting electron injector, i.e., which does not use a room temperature section, suitable for a superconducting linac, is discussed. The availability of 5-cell 1.5 GHz cavities is assumed. A single cell superconducting cavity for preacceleration, followed by two standard 5-cell cavities for capture and acceleration is suggested. The injector elements are described. Simulations indicate that using a single cell cavity as preaccelerator permits a good capture of electrons in velocity of light multicell cavities despite the fringing field and a standard high voltage electron gun.

15616 (CEA-CONF—9572) Poly articulated robot with integrated laser beam. Gonnord, J.; Garrec, P.; Beaucourt, P. de; Noel, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Sep 1988. 16p. (In French). (CONF-8809123—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756409/JAW.

From International congress on optical science and engineering; Hamburg, F.R. Germany (22 Sep 1988).

The ROLD program is born by association of two concepts: an articulated hollow system with five axes, sufficiently thin to be introduced into the standard aperture of a hot cell, the integration of a power CO/sub 2/ laser beam in the manipulator arm, capable of executing properly the cutting up of metallic structures. In this paper we present the main characteristics of the robot and laser and the lessons burned in an introducing test in a mock up.

15617 (CEA-CONF—9615) Investigation of the structure of the Nb barrier of Chevrel phase composite. Couach, M.; Khoder, A.F.; Monnier, F.; Sergent, M.; Chevrel, R.; Le Lay, L.; Dubots, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR). Dept. de Recherche Fondamentale; Rennes-1 Univ., 35 (FR); Compagnie Generale d'Electricite (CGE), 91 - Marcoussis (FR)). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756420/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

In the process of elaboration of composite superconducting wires bases on the Chevrel phases compound SnMo/sub 6/S/sub 8/, a niobium barrier should be introduced between the stabilizer (Cu) and the superconductor to prevent Cu diffusion which degrades the critical properties. During subsequent heat treatments Sn diffusion in the Nb barrier arises and many Nb-Sn phases are formed. We studied extensively the structure of the Nb barrier by the AC susceptibility and identified the Nb-Sn resulting phases.

15618 (CONF-880631—60) The procedures used to review safety analysis reports for packagings submitted to the US Department of Energy for certification. Popper, G.F.; Raske, D.T.; Turula, P. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003979/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper presents an overview of the procedures used at the Argonne National Laboratory (ANL) to review Safety Analysis Reports for Packagings (SARPs) submitted to the US Department of Energy (DOE) for issuance of a Certificate of Compliance. Prior to certification and shipment of a packaging for the transport of radioactive materials, a SARP must be prepared describing the design, contents, analyses, testing, and safety features of the packaging. The SARP must be reviewed to ensure that the specific packaging meets all DOE orders and federal regulations for safe transport. The ANL SARP review group provides an independent review and evaluation function for the DOE to ensure that the packaging meets all the prescribed requirements. This review involves many disciplines and includes evaluating the general information, drawings, construction details, operating procedures, maintenance and test programs, and the quality assurance plan for compliance with requirements. 14 refs., 6 figs.

15619 (CONF-890304—2) World modelling and multisensor integration for a mobile robot. Beckerman, M.; Farkas, L.A.; Jones, J.P.; Mann, R.C.; Glover, C.W. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005124/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

In this paper we present a strategy for the reduction of systematic errors through the fusion of ultrasonic range and visual intensity information. This is done within a framework consisting of several world models, integration procedures, and sensor models which include appropriate sensor-specific signal and information processing algorithms. Among the world models are linked lists of geometric features extracted from the intensity images, and 2D Cartesian maps built from the sonar range data. Spatial reasoning was used in the fusion of ultrasonic data from multiple scans, and in the analysis of visual edge information following exchange of range and angular information across the sensor domains. 11 refs., 9 figs.

15620 (CONF-890304—11) Sensor capabilities for the HERMIES experimental robot. Killough, S.M.; Hamel, W.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003180/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Center for Engineering Systems Advanced Research at the Oak Ridge National Laboratory has developed an experimental robot, the HERMIES, to test artificial intelligence concepts. This paper describes the capabilities provided for navigation and control. The authors conclude that the sensor suite, which enables the robot to recognize, locate, and grasp objects, makes HERMIES IIB a powerful tool for robotics and artificial intelligence research. 7 refs., 11 figs.

15621 (DP-MS—88-66) Remote robotic technology development for the new plutonium production facility. Heckendorn, F.M. II; Duncan, N.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1988]. Contract AC09-76SR00001. 9p. (CONF-890304—21). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89004047/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Savannah River Laboratory (SRL) in Aiken, South Carolina, is developing remote robotics technology, in conjunction with the Savannah River Plant (SRP), to support a new generation of plutonium production facilities. The present conventional glove box facilities are based on 1950's design technology and are obsolete. Future potential process changes and possible additional tasks increase the need for a newer technology facility. The design objectives for the new facilities are to minimize personnel exposure, both operating and maintenance, and to maximize SNM accountability and safeguards. Therefore, the process systems would be contained in a totally remote environmental designed for no personnel entry over its lifetime. These concepts required new robotic and robotic interface technologies. The conceptual design is complete, and work is progressing in the development and demonstration phases. The robotic approaches taken are described in this paper, in the context of the overall facility design, which is specifically tailored for robotics. 4 figs.

15622 **(DP-MS—88-86) Mobile underwater robotic cleaning and inspection device for radioactive environments.** Heckendorn, F.M.; Silverman, E.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1988]. Contract AC09-76SR00001. 9p. (CONF-890304—20). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004048/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

A Mobile Underwater Robotic Cleaning and Inspection (MURCI) device has been developed for the specialized requirements of the Nuclear Industry. It has subsequently been applied to a variety of underwater applications requiring a teleoperated device for remote removal of potentially radioactive sludge, solids, and contamination. The underwater inspection capabilities are applicable both as a supplement to the cleaning function and in stand alone applications for surveillance. 3 figs.

15623 **(DP-MS—88-93) Mobile tele-operator for removing a contaminated junction box.** Ward, C.R.; Rankin, W.N. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1989. Contract AC09-76SR00001. 7p. (CONF-890304—25). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004772/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

At the Savannah River Plant a leak of radioactive liquid in an equipment corridor had contaminated the inside of a junction box to a level of 200 R measured at the exterior surface. The box would have to be removed to allow normal maintenance and repair of equipment in this section of the corridor. It was estimated that a total exposure of 8 R would be required to remove the box manually, even with tools mounted on long poles. The Robotics group at the Savannah River Laboratory was asked to develop a method to remotely remove this junction box. The Robotics group, with assistance from the Interim Waste group, obtained a hydraulic cutter that was capable of making the 13 cuts required to remove the box. The cutter blades were of a special design that could cut through the 2-inch conduit with minimum force. A Pedsco mobile tele-operator was extensively modified to manipulate the cutter. A new upper arm assembly in the elbow-up configuration was installed, a tool-mounted camera was installed, and two additional degrees of freedom were added: a wrist rotate and a wrist pitch. The cutter attachment was designed to allow the cutter to be placed in three different orientations on the wrist, so that it could make all the cuts. 1 ref., 6 figs.

15624 **(DP-MS—88-95) Lead removal from radioactive vessels using a mobile robot.** Heckendorn, F.M.; Fogle, R.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1988]. Contract AC09-76SR00001. 5p. (CONF-890304—24). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004773/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Robotics Development Group at the Savannah River Laboratory (SRL) has developed and implemented a technique for removing lead counterweights from highly radioactive ion exchange vessels using a large teleoperated mobile robot and custom design tooling. The ion exchange vessels or deionizers present both a radiation and a contamination hazard and therefore the lead cannot be removed manually by plant personnel using hand tools. Remote handling and manipulation techniques using a mobile robot and pneumatically operated power tools have been used to successfully remove lead from 10 deionizer vessels. 6 figs.

15625 **(DP-MS—88-96) Multipurpose robotic vehicle development at Savannah River.** Fogle, R.F.; Lewis, W.I. III. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1989. Contract AC09-76SR00001. 7p. (CONF-890304—17). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004383/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Robotics Development Group at the Savannah River Laboratory is developing a teleoperated mobile robotic vehicle for use in a broad range of applications. The basic design criteria are to develop a highly manueverable, weatherproof mobile robotic arms as well as a wide array of environmental sensors. Planned uses of this robotic vehicle include radiation monitoring and logging, decontamination activities, and surveillance. The main justifications for mobile robotic vehicle development at Savannah River are the prevention of radiation exposure and contamination to personnel. This paper discusses the development of a multipurpose mobile robot to be used for remote tasks and emergency response applications. 2 refs., 8 figs.

15626 **(DP-MS—88-97) Remote reactor vessel inspections at Savannah River Plant.** Lewis, W.I. III; Goodwin, B.W.; French, T.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1988]. Contract AC09-76SR00001. 8p. (CONF-890304—26). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004771/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Equipment Engineering Division of the Savannah River Laboratory has recently completed the development of a robotic inspection system for use in conducting full volumetric examinations of the site's reactor tanks. The development of the inspection equipment was necessary to obtain quantitative volumetric data on the structural integrity of the tanks such that service life could be evaluated. The development program included the design and fabrication of four, five-axis robotic inspection tools, six three-axis camera and lighting masts, video equipment, mobile control centers, complete mockup and testing facilities, and the integration of ultrasonic and eddy current data collection equipment. This paper gives a brief history of past reactor vessel inspections. The need, justification, and implementation of the development effort is then discussed. The various system components developed including the tools, controls, data acquisition systems, etc. are discussed along with the unique design constraints each had to meet and how each supports the overall inspection system. Implementation of the inspection system in the field and future development acres to increase the equipments versatility are also described. 2 refs., 9 figs.

15627 **(DP-MS—88-99) Application-based control of an autonomous mobile robot.** Fisher, J.J. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 9p. (CONF-890304—19). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004380/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

Industry response to new technology is governed, almost without exception, by the systems available to meet real world needs, not tools which prove the feasibility of the technology. To this end, SRL is developing robust control strategies and tools for potential autonomous vehicle applications on site. This document describes the work packages developed to perform remote tasks and a integrated control environment which allows rapid vehicle applications development and diagnostic capabilities. 5 refs., 7 figs.

15628 **(DTH-DCAMM—368) Two papers in structural reliability analysis.** Bjerager, P.; Krenk, S. (Danmarks Tekniske Hoejskole, Lyngby. Danish Center for Applied Mathematics and Mechanics). Dec 1987. 23p. Available on loan from Risoe Library, DK-4000 Roskilde.

In the first paper the reliability with respect to plastic collapse of a discretized ideal plastic structure is formulated on basis of the lower bound theorem of plasticity theory. The reliability is calculated by a first order reliability method (FORM) in which the approximation points on the failure surface in the space of normalized and independent Gaussian variables is found by a suggested directional search procedure. When the yield functions are piecewise linear and the basic variables are normally distributed, the approximation is found by use of linear programming (LP), and it is demonstrated how LP and FORM can be combined. In particular, the gradient vector of the failure function for the structure with respect to plastic collapse is needed in the computation, and it is shown how this vector can be calculated. The directional search procedure is applied to two examples. In the second paper the parametric sensitivity of the most likely failure point as known in first order reliability analysis is studied. A formula is established for the deriv-

ative of the unit normal vector to the failure surface in this point. Also the derivative of the first order reliability index is a result of the analysis, and a geometrical interpretation of the result is given. The derivatives have important applications in structural system reliability and outcrossing analysis. An example illustrates the results. (AB).

15629 (DTH-DCAMM—368, pp 1-17) **Plastic systems reliability by LP and FORM.** Bjerager, P. Dec 1987. Available on loan from Risoe Library, DK-4000 Roskilde.

In Two papers in structural reliability analysis.

The reliability with respect to plastic collapse of a discretized ideal plastic structure is formulated on basis of the lower bound theorem of plasticity theory. The reliability is calculated by a first order reliability method (FORM) in which the approximation points on the failure surface in the space of normalized and independent Gaussian variables is found by a suggested directional search procedure. When the yield functions are piecewise linear and the basic variables are normally distributed the approximation is found by use of linear programming (LP), and it is demonstrated how LP and FORM can be combined. In particular, the gradient vector of the failure function for the structure with respect to plastic collapse is needed in the computation, and it is shown how this vector can be calculated. The directional search procedure is applied to two examples. (author) 25 refs.

15630 **(INIS-BR—1400) Thermoluminescence dosimeters based on brazilian solid fluorite.** Trzesniak, P. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1985. 119p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705513/JAW.

We describe the fabrication of a new dosemeter for X and γ radiation based on fluorite for personal dosimetry. (M.W.O.).

15631 (INIS-SU—64, pp 64-65) **Abstract of the TUBE-1 program.** Sergeeva, L.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The TUBE-1 program (FORTRAN, BESM-6 computer) for computerized simulation of crack propagation kinetics in pipelines under the effect of hydrogen embrittlement is described. The pipe is supposed to be endless. The crack-type defect begins to develope from an external surface and propagates along the forming pipe. 4 refs.

15632 **(INPE—4380) Analysis on a electron gun for metal fusion.** Paes, A.C.J.; Galvao, R.M.O.; Boscolo, P.; Passaro, A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Sep 1987. 27p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705534/JAW.

The characteristics of the electron beam of the HK-011600 Δ, electron gun for metal fusion at the 'Divisao de Materiais do Instituto de Pesquisa e Desenvolvimento do CTA (PMR/IPD/CTA)', is analyzed. In this analysis, the Pierce gun model and the SLAC computational code for electron optics are used. The electron beam R and Z profiles are obtained in the gun region and in the magnetic lenses region. The behaviour of the electron beam in the prism region is also discussed using a simple model.

15633 **(K/ITP—112) Load-cell-based weighing system (LCBWS) equipment survey.** Cooley, J.N.; Huxford, T.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Sep 1988. Contract AC05-84OT21400. 37p. (ISPO—271). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006488/JAW.

Based on results of an International Atomic Energy Agency (IAEA) field test of the prototype 20-ton-capacity Load-Cell-Based Weighing System (LCBWS), a modified LCBWS is being configured for routine IAEA field use in verifying the masses of 10- and 14-ton UF_6 cylinders. The modified system is being designed to meet IAEA objectives for accuracy and portability as well as to meet facility operating safety conditions. To best meet these design requirements, a comprehensive survey of commercially available weighing equipment was conducted. Detailed equipment specifications for 25 load cells from 17 manufacturers, for 5 digital crane scales from 3 manufactures, and for 7 digital weight indicators from 5 manufacturers were compared. The recommended system configuration is a custom-designed load cell in conjunction with a production digital weight indicator. Safety certification of the system by an internationally recognized verification authority is also recommended. Comparison criteria and their effect on the LCBWS design requirements are discussed, and the status of the project is reported. 6 refs., 27 figs., 4 tabs.

15634 **(LA-UR—88-3497) Design of an automated powder-handling process for isotope detector fabrication.** Knobeloch, D.W.; Ford, R.F. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-890304—13). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003466/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

During the assembly of isotope detectors, operating personnel manipulate many different types of highly radioactive oxides. The energetic radiation from these oxides presents an exposure problem to operating personnel. Because of the routine nature of this process and the need to minimize radiation exposures to operating personnel, automation was recognized as a means to address these issues. A robot arm was selected as the material transfer device to interact with several automated subsystems. The subsystems will perform the necessary manipulations to weigh and transfer the oxides into the target capsules. The equipment used in this project includes a Precision Robot Inc. PRI-1100 robot arm, a custom-designed glovebox for the robot arm, a pneumatically operated, custom end effector, a cutting device used to open the oxide container, an automated powder feeder, and an electronic balance. The entire system is designed to operate via an IBM personal computer. The computer control system also provides data base capabilities to store pertinent data about each batch of oxide that is processed by the system. 1 fig.

15635 **(LBL—24991) Superconducting magnetic energy storage.** Hassenzahl, W. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 9p. (CONF-880812—36). NTIS, PC A03 - OSTI. Order Number DE89006658/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

Recent programmatic developments in Superconducting Magnetic Energy Storage (SMES) have prompted renewed and widespread interest in this field. In mid 1987 the Defense Nuclear Agency, acting for the Strategic Defense Initiative Office, issued a request for proposals for the design and construction of SMES Engineering Test Model (ETM). Two teams, one led by Bechtel and the other by Ebasco, are now engaged in the first phase of the development of a 10 to 20 MWhr ETM. This report presents the rationale for energy storage on utility systems, describes the general technology of SMES, and explains the chronological development of the technology. The present ETM program is outlined; details of the two projects for ETM development are described in other papers in these proceedings. The impact of high T/sub c/ materials on SMES is discussed. 69 refs., 3 figs., 3 tabs.

15636 **(MLM—3574) An independent electrical heater for the standardization of radiometric calorimeters.** Otto, G.W. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 24 Feb 1989. Contract AC04-88DP43495. 33p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007301/JAW.

The electrical standardization heater is a National Institute of Standards and Technology (NIST) traceable standardization device for calorimeters based on Joulean heating. It may be used on all calorimeters of present and past design. Tests over a wide power range show that the replacement heater is fully equivalent to radiometric heat standards for calorimeter standardization. The replacement heater may confidently be used in lieu of heat standards when circumstances preclude their use. 10 figs., 4 tabs.

15637 (N—89-12626, pp 9-32) **Low-speed flexible rotor balancing for smooth, high-speed operation.** Zorzi, E.; Giordano, J.; Vonpragenau, G.L. (Mechanical Technology, Inc., Latham, NY (USA)). Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

A method for balancing flexible rotors at low speeds while ensuring smooth high-speed operation was developed and demonstrated through proof-of-principle tests. A potential application of this method is for the Space Shuttle Main Engine (SSME) turbopump rotors. These rotors operate above one or more critical speeds and must be balanced to ensure smooth operation at those speeds. Conventional low-speed rigid balancing is inadequate. The SSME hardware and geometry restrictions preclude the use of high-speed, flexible rotor, in-housing balancing. The use of a low-speed flexible rotor balancing method could substantially improve the state of balance of these rotors, because this technique eliminates the need for the high-speed runs during the balancing process required by classical flexible rotor balancing methods. The analytic formulation of the low-speed flexible rotor balancing method is described and the results of the proof-of-principle tests are presented. These results indicate that low-speed flexible rotor balancing is not only a viable technology, but that it is a valuable method for ensuring smooth operation above more than one bending critical speed. Also, the High-Pressure Oxygen Turbopump (HPOTP) rotor is shown to be a candidate application for this month.

15638 (N—89-12626, pp 221-240) **Thermo-mechanical performance evaluation of cryogenic turbopump ball bearings.** Pallini, R.A. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The Space Shuttle Main Engine (SSME) high pressure oxidizer turbopump (HPOTP) presents a severe and demanding operating environment for the rotor-bearing system. The life requirement for the angular contact ball bearings that support the shaft is on the order of 7.5 hours. In actual operation bearing distress was observed after much shorter time. A thermo-mechanical analysis of the HPOTP rotor-bearing system was performed with the SHABERTH (SHaft-BEaring-THermal) computer code. Bearing performance was evaluated as a function of its thermal and mechanical environment. Bearing operating temperatures, heat generation and rolling fatigue life were quantified as functions of operating loads and ball-to-race friction. The latter of these was shown to greatly influence bearing performance. Recommendations for easing the sensitivity of bearing performance to friction levels is addressed.

15639 **(SAND—88-0560) Trafficability probe testing in sand and clay targets with ground launches and air drops.** Foster, A.D.; Young, E.R. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 388p. NTIS, PC A17/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007063/JAW.

In August and September 1982, a series of tests was conducted at the Marine Base, Camp Pendleton, California, and at Willcox Playa, Willcox, Arizona, using an air gun and a helicopter to launch instrumented penetrators into sand and clay targets. The purpose of the tests was to collect penetrator deceleration and structural response data, soil resistivity during soil penetration, and other IN SITU soil information. This series of tests was a continuation of a series of tests conducted in September 1981 to assess the feasibility of establishing the type and strength of the soil encountered from the measured data. 130 refs., 90 figs., 14 tabs.

15640 **(SAND—88-2140C) Combining segmentation and tracking for the classification of moving objects in video scenes.** Donohoe, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-8810202—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007000/JAW.

From 22. Asilomar conference on signals, systems and computers; Pacific Grove, CA, USA (30 Oct 1988).

This paper describes a method of detecting, tracking and identifying moving objects in video scenes. The method is based on an adaptive change detector which detects and tracks moving objects and extracts silhouettes of the objects from the background so they can be classified by shape. The adaptive change detector uses estimates of image noise and contrast to dynamically adjust decision thresholds. A principal feature of this method is the synergistic interaction between the tracker, the segmenter and the classifier to eliminate uninteresting objects, to improve estimates of the background and noise, to guide threshold selection, and to influence feature selection classification. 9 refs., 4 figs.

15641 **(UCRL—99282) The effects of variations in the photocathode voltages of electronic streak cameras.** Bowers, M.W.; Biggs, G.L.; Ronchetto, J.J.; Teruya, A.T. (Lawrence Livermore National Lab., CA (USA)). 8 Aug 1988. Contract W-7405-ENG-48. 10p. (CONF-880887—30). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006776/JAW.

From 32. international technical symposium on optical and opto-electronic applied sciences and engineering; San Diego, CA, USA (14 Aug 1988).

Electronic streak cameras are used to record subnanosecond data at the Nevada Test Site. It has been found that externally induced variations in the photocathode voltage of the streak tube can produce both temporal and spatial errors on the output image. An electron beam tracing code was used to model the magnification as a function of photocathode voltage and signal input position for streak tubes manufactured by RCA, ITT, and Kentech. Laboratory tests were also performed where pulsed and radio frequency signals were induced upon the photocathode and the errors on the resultant image were compared with the error predicted by the electron beam code. Also, methods for processing the distortion in digitized images were investigated. This paper will discuss the results of these investigations. 3 refs., 17 figs.

15642 **(WI—9006596) Safety factors in the assessment of realistic defects in pipeline welds: Final report.** Hodgson, A.P.; Leggatt, R.H. (Welding Inst., Cambridge (UK)). Oct 1988. 153p. American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209. Order Number TI89006596/JAW.

An investigation of the theoretical safety factors inherent in the proposed Level 1, 2 and 3 procedures set out in the revised BSI PD6493 document has been conducted for the assessment of realistic long surface defects at welds using two dimensional elastic-plastic finite element models. The numerical models were validated by comparison with experimental behavior. The validation studies considered the effects of the shape of the stress-strain curve, the type of lateral constraint and the introduction of dual material properties into the models. The variables investigated in the analysis of realistic defects at welds included load level, flaw depth and position, overmatching weld metal, weld cap reinforcement and residual stresses. Modified procedures for the Level 2 and Level 3 treatment of residual stresses were investigated. The project is a follow-on to PR-164-508. 10 refs., 68 figs., 9 tabs.

15643 **Acoustical properties of drill strings.** Drumheller, D.S. (Geothermal Research Division, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of the Acoustical Society of America;* **85**: No. 3, 1048-1064(Mar 1989).

The recovery of petrochemical and geothermal resources requires extensive drilling of wells to increasingly greater depths. Real-time collection and telemetry of data about the drilling process while it occurs thousands of feet below the surface is an effective way of improving the efficiency of drilling operations. Unfortunately, due to hostile down-hole environments, telemetry of this data is an extremely difficult problem. Currently, commercial systems transmit data to the surface by producing pressure pulses within the portion of the drilling mud enclosed in the hollow steel drill string. Transmission rates are between 2 and 4 data bits per second. Any system capable of raising data rates without increasing the complexity of the drilling process will have significant economic impact. One alternative system is based upon acoustical carrier waves generated within the drill string itself. If developed, this method would accommodate data rates up to 100 bits per second.

Unfortunately, the drill string is a periodic structure of pipe and threaded tool joints, the transmission characteristics are very complex and exhibit a banded and dispersive structure. Over the past 40 years, attempts to field systems based upon this transmission method have resulted in little success. This article examines this acoustical transmission problem in great detail. The basic principles of acoustic wave propagation in the periodic structure of the drill string are examined through theory, laboratory experiment, and field test. The results indicate the existence of frequency bands that are virtually free of attenuation and suitable for data transmission at high bit rates.

15644 **Superconducting magnet designs for the SSC and RHIC.** Thompson, P.A.; Cottingham, J.; Dahl, P.; Brown, D.; Garber, M.; Ghosh, A.K.; Goodzeit, C.; Greene, A.; Hahn, H.; Herrera, J. (Brookhaven National Lab., Building 902-B, Upton, NY (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

This paper reviews the main dipoles for RHIC, which are 9.7 meters long with an operating field of 3.45 T. Four full size dipoles have been tested and all exceeded the operating field. The main dipoles for the SSC project are 17 meters in length with an operating field of 6.6 T. Five of these have been tested. Rough calculations show that the possibility of operating future such large colliders at —80 K instead of —4 K is unlikely to have a major impact upon their cost or feasibility. However, increasing the critical field of practical superconductors (either by lowering the operating temperature or further conductor development) could have a major impact upon the specialized magnets used in the intersection regions of such machines.

15645 **Maglev.** Johnson, L.R.; Giese, R.F. (Center for Transportation Research, Energy and Environmental Systems Div., Argonne National Lab., 9700 South Cass Ave., Argonne, IL (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

This paper discusses the potential for magnetically levitated (maglev) vehicles as a means of both inter-city travel and a technology option to relieve the growing problem of air traffic congestion. It begins with a brief summary of the two primary maglev concepts: (1) the attractive-force, electromagnetic system (EMS) and (2) the repulsive-force, electrodynamic system (EDS), and continues with a discussion of the advantages, potential for reduced costs and higher reliability, that the newly discovered, high-temperature superconductors offer for EDS maglev vehicles. A summary of the current status of worldwide maglev research is presented, followed by a discussion of the resurgence of U.S. interest in maglev. An analysis of air-traffic congestion suggests that maglev can substitute for short-to-medium distance air travel. By promoting maglev as an airline technology, airlines can retain their familiar hub-and-spoke systems with maglevs an integral part of the spoke portion. Maglev energy consumption would be significantly less and would not have the emissions associated with petroleum fuel. Because maglev vehicles, cruising at speeds of 300 mi/h, are essentially a fuselage without wings, aircraft manufacturers could be the logical industry to build them. Finally, passengers should benefit from maglev technology: travel options will be extended, delays will be reduced, and costs for inter-city travel will be reduced.

15646 **Surface analysis of interfacial properties for thin film and bulk YBa/sub 2/Cu/sub 3/O/sub 7/.** Nelson, A.J.; Kazmerski, L.L.; Mason, A.R.; Swartzlander, A.B.; McConnell, R.D. (Solar Energy Research Institute, Golden, CO (US)); Ono, R.; Beall, J.; Ekin, J.W. (National Bureau of Standards, Boulder, CO (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

Auger electron spectroscopy (AES) has been used to characterize the surface and grain boundary chemistry of thin film YBa/sub 2/Cu/sub 3/O/sub 7/ and the interface chemistry between In and Ag contacts to bulk YBa/sub 2/Cu/sub 3/O/sub 7/ before and after the standard post-deposition annealing. Compositional variations at grain boundaries as well as substrate effects have been related to the observed non-linear tailing in the resistivity vs. temperature curves. In addition, AES analysis of the contact/YBa/sub 2/Cu/sub 3/O/sub 7/ interfacial chemistry is used to explain the large variations in contact resistances observed for these technologically important materials.

15647 **Ceramic fabrication technology for high-T/sub c/ materials.** Lanagan, M.T.; Goretta, K.C.; Singh, J.P.; Goudey, G.T.; Dusek, J.T.; Dos Santos, D.I.; Poeppel, R.B. (Argonne National Lab., 9700 South Cass Ave., Argonne, IL (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

Three basic processes for the fabrication of high-T/sub c/ superconductors are discussed. Superconducting wires of YBa/sub 2/Cu/sub 3/O/sub 7-x/ are fabricated by extrusion. Tape casting and thick film technology are used for the manufacture of YBa/sub 2/Cu/sub 3/O/sub 7-x/ and silver composite structures. Grain orientation is observed for extruded and tape cast specimens, and is attributed to high shear stresses during plastic forming.

15648 **Cryogenic systems for detectors and particle accelerators.** Sondericker, J.H. (Brookhaven National Lab., Associated Universities Inc., Upton, New York, NY (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

It's been one hundred years since the first successful experiments were carried out leading to the liquefaction of oxygen which birthed the field of cryogenics and about sixty years since cryogenics went commercial. Originally, cryogenics referred to the technology and art of producing low temperatures but today the definition adopted by the XII Congress of the International Institute of Refrigeration describes cryogenics as the study of phenomena, techniques, and concepts occurring at our pertaining to temperatures below 120 K. Modern acceptance of the importance and use of cryogenic fluids continues to grow. By far, the bulk of cryogenic products are utilized by industry for metal making, agriculture, medicine, food processing and as efficient storage of fuels. Cryogenics has found many uses in the scientific community as well, enabling the development of ultra low noise amplifiers, fast cold electronics, cryopumped ultra high vacuums, the production of intense magnetic fields and low loss power transmission through the sue of cryogenically cooled superconductors. High energy physic research has been and continues to use cryogenic hardware to produce liquids used as detector targets and to produce refrigeration necessary to cool superconducting magnets to design temperature for particle accelerator applications. In fact, today's super accelerators achieve energies that would be impossible to reach with conventional copper magnets, demonstrating that cryogenics has become an indispensable ingredient in today's scientific endeavors.

15649 **Design approaches and parameters for magnetically levitated transport systems.** Danby, G.T.; Powell, J.R. (Brookhaven National Lab., Upton, NY (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

Mechanically levitated transport system approaches are assessed with regard to thrust power needs, track cost, suspension stability, and safety. The null flux suspension appears as the favored approach, having the least thrust power requirements, highest stability, and lowest amount of track material. Various null flux configurations are described, together with operating parameters. The Linear Synchronous Motor (LSM) propulsion system is also described for propelling the suspended vehicles. Cryogenics and superconductivity aspects are discussed and the effect of high T/sub c/ superconductors evaluated.

15650 **High-power RF applications of high-T/sub c/ superconductors.** Delayen, J.R.; Lanagan, M.T. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

The rf surface resistance of YBa/sub 2/Cu/sub 3/O/sub 7-x/ was measured by sa half-wave resonant coaxial line technique for bulk ceramic and thick film samples. The surface resistance was found to be dependent upon frequency, temperature, and rf field level. A comparison between design criteria for high power cavities and measured properties was carried out to determine the utility of the YBa/sub 2/Cu/sub 3/O/sub 7-x/ superconductor.

15651 **The use of high temperature superconductors in magnetoplasmadynamic systems.** Reed, C.B. (Argonne National Lab., Argonne, IL (US)); Sovey, J.S. (NASA Lewis Research Center, Cleveland, OH (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

The use of Tesla-class high-temperature superconducting magnets may have an extremely large impact on critical development issues (erosion, heat transfer, and performance) related to MPD thrusters and also may provide significant benefits in reducing the mass of magnetics used in the power processing system. These potential performance improvements, coupled with additional benefits of high-temperature superconductivity, provide a very strong motivation to develop high-temperature superconductivity (HTS) applied-field magnetoplasmadynamic (MPD) thruster propulsion systems. The application of HTS to MPD thruster propulsion systems may produce an enabling technology for these electric propulsion systems. This paper summarizes the impact that HTS may have upon MPD propulsion systems.

15652 **Application of superconducting technology to earth-to-orbit electromagnetic launch systems.** Hull, J.R. (Argonne National Lab., Argonne, IL (US)); Carney, L.M. (National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH (US));. pp v of Superconductivity and its application. 103. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

Benefits may be realized by incorporating superconductors, both existing ones and those currently under development, in one or more parts of a large-scale electromagnetic launch (EML) system that is capable of delivering payloads from the surface of the Earth to space. The use of superconductors for many of the EML components result in lower system losses; consequently, reductions in the size and number of energy storage devices are possible. Applied high-temperature superconductivity may eventually enable novel design concepts for energy distribution and switching. All of these technical improvements have the potential to reduce system complexity and lower payload launch costs.

15653 **Effect of oxygen annealing on low-resistivity contacts for high-T/sub c/ superconductors.** Ekin, J.W.; Panson, A.J.; Blankenship, B.A. (Electromagnetic Technology Div., National Bureau of Standards, Boulder, CO (US));. pp v of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

A method for making low resistivity contacts to high-T/sub c/ superconductors has been developed, consisting of depositing noble metal contact pads (silver or gold) on a clean superconductor surface at low temperatures (<150°C). After annealing the silver contact pads in oxygen at intermediate temperatures (≦500°C) for one hour, contact resistivities less than 2 x 10/sup -8/ Ω-cm/sup 2/ at 76 K are obtained, about six orders of magnitude less than for indium-solder contacts. Before annealing, the contact resistivities are still very low, in the 10/sup -6/ to 10/sup -5/ Ω-cm/sup 2/ range at 76 K, which would be useful when contacts with low fabrication temperatures are required. The voltage-current characteristics of the contacts are strongly nonlinear after annealing, having a superconducting transition character. This is ascribed to the critical current of the superconducting material being exceeded at the contact interface. External connections to the contact pads have been made using both solder and thermosonic wire-bonding techniques.

15654 **Recent advances in structural dynamics.** Chung, H.; Fisher, H.D. New York, NY; American Society of Mechanical Engineers (1987). 181p. (CONF-870636—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

This book contains 23 selections. Some of the titles are: On the statics of supports and the geometry of wrinkling of large spherical pressure vessels; Computer aided analysis of horizontally supported pressure vessels; Piping system vibration evaulation; and System response of a feedwater line during blowdown loading.

4203 Lasers

REFER ALSO TO CITATION(S) 15304, 15305, 15457, 15791, 15824, 15837, 16065, 16612, 16749, 16793, 16798, 16814, 16830, 16831, 16911

15655 **(BNL—41996) 3-D numerical analysis of a high-gain free-electron laser.** Gallardo, J.C. (Brookhaven National Lab., Upton, NY (USA)). 19 Oct 1988. Contract AC02-76CH00016. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006981/JAW.

We present a novel approach to the 3-dimensional high-gain free- electron laser amplifier problem. The method allows us to write the laser field as an integral equation which can be efficiently and accurately evaluated on a small computer. The model is general enough to allow the inclusion of various initial electron beam distributions to study the gain reduction mechanism and its dependence on the physical parameters. 16 refs., 8 figs., 1 tab.

15656 **(DOE/DP/40208—T1) Study of nuclear fluorescence excited by laser plasma x-rays: Final report, 10 September 1984--31 July 1988.** Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics). 17 Oct 1988. Contract AS08-84DP40208. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006453/JAW.

The ultimate objective of the part of the research conducted under this contract was to demonstrate the feasibility of accelerating the radioactive decay of populations of long-lived isomeric states of nuclear excitation. Such an achievement would represent a substantial step along the path of research which might ultimately lead to a gamma-ray laser. Quantitative modeling has indicated that such a result might be obtained through a type of optical pumping with laser plasma X-rays produced by conventional devices of realistic size. The research necessary to test the overall viability of the concept is being pursued at the Center for Quantum Electronics of the University of Texas at Dallas. The work conducted under this contract was the first step of a type of scaling study that would in-

dicate how close to threshold the medium for a gamma-ray laser could be pumped with existing fusion lasers. Calculations had indicated that if a suitable "ideal" medium can be found, the threshold for a gamma-ray laser would be attained before breakeven in fusion. This first phase of research was focused upon the demonstration of the overall efficiency for the coupling of x-radiation into γ-ray fluorescence through the absorption by a nuclear ground state population of X-radiation from a laser plasma. As no actual laser shots were ever allocated, only theoretical results are available. 25 refs., 6 figs., 1 tab.

15657 **(DOE/ER/30131—T1) Assessment of research needs for laser technologies applied to advanced spectrographic methods: Project status report.** (Consultec Scientific, Inc., Knoxville, TN (USA)). 31 Jan 1989. Contract AC01-88ER30131. 6p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006455/JAW.

Our project to assess the DOE/OHER research needs for laser technologies applied to advanced spectrographic methods is progressing well and on schedule. The main panel met in Knoxville in November 1988 to discuss the impact that laser spectroscopy and technology could make on future directions of the OHER. It was a very enthusiastic meeting which resulted in a number of quite valuable suggestions. Following this meeting, nearly every panel member has completed his first assignment, and, as anticipated, the work has been extremely good. My only objection is that of length; we have now amassed about 150 double-spaced pages. Generally speaking, we now need to look for gaps, decide on deletions, and then proceed with the project.

15658 **(LA-UR—88-4114) XUV free-electron laser development at Los Alamos.** Newnam, B.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-881151—52). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005458/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

Free-electron lasers (FELs) for the vacuum-ultraviolet and soft x-ray spectral regions (together termed the XUV) are being developed at Los Alamos for integration into a proposed national UV/XUV FEL user facility for scientific experimentation. This facility would consist of a sequence of up to 15 FEL oscillators and amplifiers, driven by a single, rf-linear accelerator, that will generate broadly tunable, picosecond-pulse, coherent radiation over the range from 1 to 400 nm. Below 300 nm, the peak- and average-power output of these FEL devices should surpass the capabilities of any existing, continuously tunable photon sources by many orders of magnitude. We list the design parameters and predicted output of these FELs and make comparison with synchrotron radiation sources. Brief mention is given to our recent progress in developing the three primary components (electron beam, magnetic undulator, and resonator mirrors). 24 refs., 2 figs., 3 tabs.

15659 **(LA-UR—88-4200) Ultrahigh-brightness XeCl laser system.** Gibson, R.B.; Gosnell, T.R.; Lester, C.S.; Robers, J.P.; Tallman, C.R.; Taylor, A.J. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890157—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005467/JAW.

From SPIE conference on high power and solid state lasers; Los Angeles, CA, USA (19 Jan 1989).

A laser system that produces terawatt-level pulses of 308-nm light with near-diffraction-limited beam quality is under development. Pulses of 175-fs duration are generated at 616 nm in a synchronously-pumped mode-locked dye oscillator. These pulses are amplified in a three-stage dye amplifier longitudinally pumped by the frequency-doubled output of a regenerative Nd:YAG amplifier. Output of the dye amplifier is frequency-doubled in a BBO crystal and amplified in a chain of XeCl excimer stages. The optical design maintains high beam quality throughout. 17 refs., 2 figs.

15660 **(LA-UR—89-19) Electron-beam pumped liquid excimer lasers.** Loree, T.R.; Showalter, R.R.; Johnson, T.M.; Birmingham, B.S.; Hughes, W.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 31p. (CONF-881244—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006549/JAW.

From LASERS '88; Lake Tahoe, NV, USA (5 Dec 1988).

We have investigated the excimers formed in liquid argon when various cryogenic gas mixes were excited by 1-MeV electrons. Fluorescence was detected from many excimers at their new red-shifted wavelengths, and XeO, Xe_2, and Kr_2 were lased. 25 refs., 12 figs.

15661 **(LA-UR—89-40) High average power excimer laser-pumped dye oscillators.** Tennant, R.A.; Whitehead, M.C.; Tallman, C.R.; Basinger, R.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-881244—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006547/JAW.

From LASERS '88; Lake Tahoe, NV, USA (5 Dec 1988).

The design, construction, and testing of a high-average-power excimer laser-pumped dye oscillator is described. The system is designed to produce up to 75 watts of average power in the near uv at a pulse repetition rate of 500 Hz. 8 figs.

15662 **(PB—89-130595/XAB) CLEO-88.** Berglund, F.; Bolander, G. (Foersvarets Forskningsanstalt, Linkoeping (Sweden). Huvudavdelning foer Informationsteknologi). Aug 1988. 25p. (FOA-C—30505-3.4). NTIS, PC E02/MF A01.

The main impression from the laser conference CLEO 88 in the USA was that strong efforts are in progress on development of semiconductor lasers. A GaAlAs-laser array was reported with an output power of 38 watts CW and 25% electric to optic efficiency. Diode-laser-pumped Nd:YAG-lasers with total efficiency of 15,7% at CW and 35% at pulsed mode were mentioned. Visual diode lasers were demonstrated and can outperform HeNe lasers in many applications.

15663 **(UCRL—96880) Validity of 1D free-electron laser sideband models.** Sharp, W.M.; Yu, S.S. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 25p. (CONF-8709110—25). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006284/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

Analytical 1D models have been used to estimate sideband growth in a free-electron laser (FEL) with a constant-amplitude primary wave. A simple 2D sideband model is used here to show that the 1D approximation is valid only when the beam radius r/sub b/ is large compared with [2 k/sub s/ min(Ω_0, d{phi}$_0$/dz)]/sup {minus}1/2/, where k/sub s/ and {phi}$_0$ are the wavenumber and phase of the primary wave and Ω_0 is the maximum synchrotron wavenumber of trapped electrons. For smaller r/sub b/values, sideband growth rates are reduced below 1D predictions, and both the growth rate scaling with beam density and the primary-wave amplitude, are altered. 7 refs., 9 figs.

15664 **(UCRL—98676) Simulation of superradiant free-electron lasers.** Sharp,W.M.; Fawley, W.M.; Yu, S.S.; Sessler, A.M.; Bonifacio, R.; deSalvo Souza, L. (Lawrence Livermore National Lab., CA (USA)). 4 Jan 1989. Contract W-7405-ENG-48. 16p. (CONF-8808146—12). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006156/JAW.

From 10. international free-electron laser conference; Jerusalem, Israel (29 Aug 1988).

It has been suggested that slippage effects in a single-pass free- electron laser can generate an output signal near the electron beam tail with a peak amplitude many times greater than the expected saturated value. The growth of such "superradiant" pulses in a helical-wiggler FEL is characterized here using 1-D and 2-D numerical simulations. The 1-D calculations show the effects of detuning, energy spread, and the axial current distribution on superradiant pulses, while preliminary 2-D simulations illustrate the effects of betatron motion and the radial structure of the electron beam. 12 refs., 6 figs., 1 tab.

15665 **(UCRL—99430) Ground State Depleted (GSD) solid state lasers: Principles, characteristics, and scaling.** Krupke, W.F.; Chase, L.L. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 18p. (CONF-890145—12). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006149/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

A novel class of rare earth doped solid state lasers is described. The Ground State Depleted (GSD) laser is pumped by an intense (>tens kW/cm²) narrowband (<few nm) laser source and is characterized by: an unusually low laser ion doping density (5-10 x 10^{18} ions/cc), an unusually large fractional excited population inversion density (4-8 x 10^{18} ions/cc or >75%), a gain element that is optically thick at the pump wavelength, a gain element that has a substantially uniform gain distribution due to a bleaching of the pump transition at the pump intensity utilized. These features enable efficient room temperature operation of rare earth ion laser transitions terminating on the ground manifold. The relationships between laser parameters (cross sections, saturation fluences and fluxes, bleaching wave velocities, etc.) are given and laser performance scaling relationships are presented and discussed. 21 refs., 12 figs., 3 tabs.

15666 **(UCRL—99458) Ground state depleted laser experiments.** Beach, R.; Solarz, R.; Mitchell, S.; Brewer, L.; Weinzapfel, S. (Lawrence Livermore National Lab., CA (USA)). 1989. Contract W-7405-ENG-48. 18p. (CONF-890145—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006146/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

Spectroscopic measurements have been performed at Livermore in various Nd doped glass and crystalline materials to extract parameters (stark resolved emission spectra, branching ratios, fluorescence lifetimes, and stimulated emission cross sections) important to the design of a GSD laser. This study has allowed us to identify several systems amenable to experimental demonstration. The results of a demonstration in one of these systems consisting of a sample of Nd doped Y_2SiO_5 which is pumped by a flash lamp pumped dye laser will be presented. Measurements are made to document the degree to which the ground state of the laser has been depleted. An important problem present in GSD lasers, illustrated by the results of our demonstration, is holding off the gain of the Nd ^{4}F/sub 3/2/ - ^{4}I/sub 11/2/ transition which typically has an emission cross section 5 to 10 times larger than the desired ^{4}F/sub 3/2/ - ^{4}I/sub 9/2/ transition cross section. Several possible techniques for holding off the ^{4}F/sub 3/2/ - ^{4}I/sub 11/2/ transition are discussed. These techniques include segmented laser designs, and the co-doping of laser samples with elements having a large absorption cross section in the 1.06 micron region while being relatively free of absorption in the 0.92 micron region of the spectrum. A system based on Y_2SiO_5 and co-doped with Nd and Sm will be presented as an example of the latter type GSD design along with available experimental results. Ground state depleted (GSD) lasers have been described in an earlier paper as room temperature, four-level, high energy density lasers with uniform gain when pumped either transversely or longitudinally. 15 refs., 12 figs., 5 tabs.

15667 **(UCRL—99702) Q-switched, intracavity doubled Nd:YAG laser side-pumped by a laser diode array.** Bass, I.L.; Presta, R.W. (Lawrence Livermore National Lab., CA (USA)). 1989. Contract W-7405-ENG-48. 9p. (CONF-890142—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005349/JAW.

From Symposium on lasers and optics; Los Angeles, CA, USA (15 Jan 1989).

An intracavity-doubled, Q-switched, Nd:YAG laser side pumped by a pulsed, 3-bar, laser-diode array, produced a second harmonic output of 1.75 mJ/pulse at an optical conversion efficiency of 11.5%. We demonstrated the use of this laser to pump a pulsed dye laser via an optical fiber. 4 refs., 5 figs.

15668 **(UCRL—100167) Bremsstrahlung radiation effects in rare earth permanent magnets.** Luna, H.; Maruyama, X.; Colella, N.; Hobbs, J.; Hornady, R.; Kulke, B.; Palomar, J. (Lawrence Livermore National Lab., CA (USA)). 15 Dec 1988. Contract W-7405-ENG-48. 21p. (CONF-8808146—13). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006207/JAW.

From 10. international free-electron laser conference; Jerusalem, Israel (29 Aug 1988).

Advances in rare earth permanent magnet (REPM) technology have made possible new applications. Two such applications are the use of permanent magnetic lenses for accelerator and beam transport systems and the expanding use in undulators and wigglers of synchrotron radiation and free electron laser systems. Both applications involve potential exposure of REPM's to high radiation fields. We have investigated the radiation hardness of several different varieties of REPM's up to 2 gigarads of absorbed dose from a mixed electron-photon (bremsstrahlung) field. Sm_2Co_{17}, $Nd_2Fe_{14}B$ and an experimental REPM, $Pr_{15}Fe_{79}B_6$, from several different manufacturers have been investigated. Of the samples irradiated, Sm_2Co_{17} proved to be the most resistant to bremsstrahlung radiation. However, details of manufacturing techniques produced significantly different results. We observed that REPM's of nominally identical stoichiometric composition from different manufacturers did not show the same rate of remanence loss. We present details of our experiment and absorbed dose modeling and a summary of radiation effects measurements of which we are aware. Our study of these radiation damage experiments lead us to the empirical observation that the order of radiation hardness is Sm_2Co_{17}, $SmCo_5$ and $Nd_2Fe_{14}B$, regardless of the source of radiation, i.e., gammas, electrons, protons or neutrons. 8 refs., 2 figs., 4 tabs.

15669 **(UCRL—100245) Laser diode cooling for high average power applications.** Mundinger, D.; Beach, R.; Benett, W.; Solarz, R.; Sperry, V. (Lawrence Livermore National Lab., CA (USA)). 1989. Contract W-7405-ENG-48. 10p. (CONF-890145—11). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006777/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

Many applications for semiconductor lasers that require high average power are limited by the instability to remove the waste heat generated by the diode lasers. In order to reduce the cost and complexity of these applications a heat sink package has been developed which is based on water cooled silicon microstructures. Thermal resistivities of less than 0.025{degree}C/(W/cm²) have been measured which should be adequate for up to CW operation of diode laser arrays. This concept can easily be scaled to large areas and is ideal for high average power solid state laser pumping. Several packages which illustrate the essential features of this design have been fabricated and tested. The theory of operation will be briefly covered, and several conceptual designs will be described. Also, the fabrication and assembly procedures and measured levels of performance will be discussed. 4 refs., 12 figs.

15670 **Characterization of the focused output from a selenium soft x-ray laser.** Nilson, D.G.; Brown, S.B.; Keane, C.J.; MacGowan, B.J.; Matthews, D.L.; Trebes, J.E.; Wood O.R. II; Silfvast, W.T.; Al-Salameh, D.Y.; Harvey, T.E.; and others. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Applied Physics Letters;* **54:** No. 9, 786-788(27 Feb 1989).

The output energy (90 μJ), focal spot diameter (235 μm), and pointing accuracy (+- 75 μrad) for a 3.7-cm-long Se soft x-ray laser operating at 20.6 and 20.9 nm are reported. Now that this intense soft x-ray source has been well characterized it may find use in such diverse applications as lithography, contact microscopy, holography, and photoionization pumping.

15671 Simulations of a ring resonator free-electron laser. Tokar, R.L.; McVey, B.D.; Thode, L.E. (Los Alamos National Lab., Los Alamos, NM (US)); Gallatin, G.M. (Research Dept., The Perkin-Elmer Corp., Danbury, CT (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **25**: No. 1, 73-83(Jan 1989).

In this paper, a relatively high gain (≈ 25 to 40 percent) free-electron laser (FEL) with an optical ring resonator is simulated using the code FELEX. The laser system corresponds to the "burst mode" FEL scheduled for operation at Boeing Aerospace Company in 1988. The ring consists of paraboloids, grazing incidence by hyperboloids, and a grating rhomb. The wiggler is 5 m in length and has an adjustable taper, while the electron beam is produced by an RF linac. The optical elements of the ring together with the FEL interaction in the wiggler are modeled in three spatial dimensions to investigate the system from start-up to saturation. Both single frequency and finite pulse simulations are performed. The study illustrates the necessity of mode matching the loaded resonator to maximize the extraction efficiency. The mode matching is necessary because the FEL interaction significantly alters the optical beam focus position and Rayleigh range. The mode-matching procedure adopted is to vary the radii of curvature of the paraboids to achieve an optical mode that resembles the lowest order Gaussian mode of the unloaded cavity. In addition, the study illustrates that the dispersion provided by the grating rhomb further increases the extraction efficiency because it improves the overlap of the optical and electron pulse. This result is consistent with one-dimensional pulse simulations for this system.

15672 Detailed optical characterization of a near diffraction limited xenon fluoride laser. Londono, C. (Polaroid Corp., Cambridge, MA (US)); Smith, M.J.; Trainor, D.W.; Itzkan, I. (Avco Research Lab., Inc. Everett, MA (US)); Berggren, R. (Los Alamos National Lab., Los Alamos, NM (US)); Fulghum, S.F. (Science Research Corp., Soemrville, MA (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 12, 2467-2476(Dec 1988).

A 1 m gain length, electron beam pumped xenon fluoride laser (λ = 353, 351 nm) utilizing two laser mixtures of lean and rich NF/sub 3/, with Xe and balance Ne, was operated with a confocal unstable resonator with magnification of 2.24. The resultant beam quality was diagnosed with both shearing interferometry to measure near-field phase and far-field focal spot evaluation techniques. These measurements resulted in a beam quality of <1.15 times the diffraction limit with no evidence of the wide angle energy loss. This laser device was fully characterized with regard to electron beam deposition uniformity, transient refractive index effects, and optical quality of the resonator and diagnostic components.

15673 Premixed cold reaction cw laser nozzle. Hook, D.L.; Broadwell, J.E. (to Secretary of the Air Force, Washington, DC). US Patent 4,785,461. 15 Nov 1988. Filed date 5 Feb 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a combustor for a premixed cold reaction CW chemical laser. The combustor consists of: a combustion chamber, the combustion chamber containing reaction products forming heated primary gas having therein atomic species of an oxidizer, the combustion chamber directing the reaction products to an output plenum; wedges positioned downstream of the output plenum to form a plurality of primary nozzles, each of the primary nozzles having an input section, a throat section, and an output section, the sections forming a supersonic nozzle to output the reaction products as a supersonic gas; secondary injectors having supersonic jets therefrom, the secondary injectors being located on exit walls substantially parallel to the streamlines of the primary nozzles and located downstream of the throat section of the primary nozzles, the secondary injectors being arranged in substantially parallel rows in a streamwise direction, each of the rows having the secondary injectors therein, the secondary injectors in a row comprising groups of secondary injectors, a first group being proximal to the throat section and injecting a diluent, a second group of secondary injectors downstream of the first group and inputting a fuel therein. The secondary injectors are at an acute angle to the exit walls, the acuteness being in the downstream direction.

15674 Comprehensive modeling of diode arrays and broad-area devices with applications to lateral index tailoring. Hadley, G.R.; Hohimer, J.P.; Owyoung, A. (Advanced Laser Technology Div., Sandia National Labs., Albuquerque, NM (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 11, 2138-2152(Nov 1988).

The authors present a numerical model for calculating the emission characteristics of diode laser arrays and broad-area devices operating well above threshold. This model employs the beam propagation technique for determining the field intensities for several lateral modes, while simultaneously and self-consistently solving for the two-dimensional current flow through the laser structure and the subsequent carrier diffusion in the active region. The active region temperature distribution is also computed in a self-consistent manner, based on the flow of heat generated in the active region through the layered device structure to a constant-temperature heat sink. They apply their model by investigating the sensitivity of the lasing modes of a broad-area diode laser to variations in the lateral temperature distribution. The results of these calculations are compared to the results of experimental studies in which they demonstrate selection and control of the lasing modes of the broad-area laser by using a focused laser beam to affect local heating. The high degree of sophistication and self-consistency in their model makes it a particularly effective tool for understanding and optimizing device behavior at high output power levels. Furthermore, the author's investigation of the effects of subtle variations in device parameters in broad-area diode lasers suggests that a tailoring of the lateral refractive index profile in these devices may offer a means of realizing fundamental-mode operation at high power levels.

15675 Gain squaring in a Cr:Nd: GSGG active-mirror amplifier using a cholesteric liquid crystal mirror. Lee, J.C.; Kelly, J.H.; Smith, D.L.; Jacobs, S.D. (Lab. for Laser Energetics, Univ. of Rochester, Rochester, NY (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 11, 2238-2242(Nov 1988).

The authors have squared the small-signal gain of a Cr:Nd:GSGG active-mirror amplifier using a passive cholesteric liquid crystal mirror. The mechanism for this gain squaring is explained in terms of the optical properties of cholesteric liquid crystals.

15676 X-ray laser gain from Bragg reflection in relativistic electron beam channel radiation systems. Strauss, M. (Dept. of Physics, Nuclear Research Center-Negev, P.O. Box 9001, Beer-Sheva (IL)); Amendt, P. (SISSA, Strada Costiera 11, Trieste (IT)); Rostoker, N. (Dept. of Physics, Univ. of California, Irvine, CA (US)); Ron, A. (Dept. of Physics, Technion, Haifa (IL));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 548-551(Oct 1988).

The application of distributed feedback by Bragg reflections in electron beam channeling X-ray lasers is investigated. Expressions for low threshold gain are derived for this cavity mirror structure in single crystals and are shown to have possible application in reducing beam high-current requirements by many orders of magnitude.

15677 Development of a sodium-pump/neon-lasant photopumped soft X-ray laser. Stephanakis, S.J.; Apruzese, J.P.; Burkhalter, P.G.; Cooperstein, G.; Davis, J.; Mosher, D.; Ottinger, P.F.; Scherrer, V.E.; Thornhill, J.W.; Young, F.C. (Naval Research Lab., Washington, DC (US)); Hinshelwood, D.D. (JAYCOR, Vienna, VA (US)); Mehlman, G. (Sachs-Freeman Associates, Inc., Landover, MD (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 472-481(Oct 1988).

Resonant photopumping of heliumlike neon by heliumlike sodium is investigated to extend this potentially efficient technique

for inversion and lasing to shorter wavelengths. Properties of the sodium-pump plasma and the neon-lasant plasma required to optimize fluorescence and lasing are determined. The implosion of a sodium-bearing plasma with a megampere pulsed-power driver (Gamble II) is used to produce a linear Z-pinch with up to 25 GW of sodium-pump-line radiation. A separate neon plasma, driven by part of the return current form the imploding sodium plasma, is created parallel to the sodium line source at a distance of 5 cm. Implosion requirements for the neon plasma and its dynamics in the Gamble II return-current geometry are described. Evidence for population inversion is indicated by fluorescence enhancement of the 11-A resonance line from the n = 4 level of neon when pumped by sodium. The neon spectra are in qualitative agreement with calculations based on the sodium-pump power. Improvements in the experiment required to achieve lasing are discussed.

15678 **Research into pulsed power-driven recombination lasers.** Krishnan, M.; Nash, T.; Lepell, P.D. (Pulsed Energy Technology Div., Physics International Co., 2700 Merced St., P.O. Box 5010, San Leandro, CA (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 491-496(Oct 1988).

The DNA/PITHON pulsed power generator was used to produce hot, dense, aluminum, and neon plasmas in a Z-pinch configuration. An annulus of neon gas was radially imploded onto a parylene capillary on axis which was coated with aluminum. The pinch produced 3 cm and 5 cm long Al/Ne plasmas with densities —10/sup 20/ cm/sup -3/ and temperatures —500 eV. A time-gated, grazing incidence spectrograph (MCPIGS) was used to image the plasma and to capture three consecutive 25 ns duration spectra. The Al XI, 4f-3d and 4-d-3p lines at 154.4 and 150.4A were observed to be anomalously bright compared to the Al XI, 4d-2p line. This anomaly, which might be suggestive of recombination lasing, may also be explained by opacity, whereby the optically thick 4 → 2 lines are reduced in apparent intensity with respect ot the 4 → 3 lines. The Ne X 4-3 line was observed to be spatially localized on axis where emissions from the Ne X 3-2 line were sharply reduced in intensity. On axis, the anomalous brightness of the Ne X 4-3 line suggests a strong inversion. The interpretation of these Ne lines should not be strongly affected by opacity considerations and is suggestive of inversions in Ne X on axis.

15679 **X-ray laser studies at LLE.** Yaakobi, B.; Boehly, T.; Audebert, P.; Epstein, R.; Boswell, B.; Richardson, M.C.; Soures, J.M. (Lab. for Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY (US)); Shvarts, D. (Nuclear Research Center-Negev, Beer-Sheva (IL));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 505-511(Oct 1988).

New target geometries for collisional excitation X-ray laser experiments (in nickel) were proposed, analyzed, and experimentally studied on the GDL laser. Experiments using a short line focus lens with new target geometries showed general agreement with predictions. The new geometries are designed to yield a higher gain and reduced refraction due to 1) a higher plasma density, 2) a wider lateral density profile, and 3) a concave lateral density profile. These new geometries were a) two parallel exploding (thin) foils, irradiated from one side only, b) two ablating (thick) foils, one of which is irradiated on its inner face, and c) an exploding foil in front of an ablating foil, irradiated by a single laser beam incident on the thin foil. The experiments with a long line focus are in progress. The intensity ratio of Ne-like and F-like Ni lines is used to deduce the temperature, and these results together with the absolute intensity yields the density profile. The results show improvement achieved with the new target geometries: the density is higher (leading to a higher gain), and the concave density profile results in collimation rather than divergence of the X-ray laser beam. Theoretical developments included development of a ray-tracing code for an amplifying medium of varying (e.g., collimating) lateral density profile (results using this code are shown for convex as well as concave lateral density profiles) and prediction of high gain on new type transitions in neonlike ions, involving the excitation of an inner (2s) electron.

15680 **Toward shorter wavelength lasers and soft X-ray laser microscopy.** Skinner, C.H.; Kim, D.; Meixler, L.; Nam, C.H.; Tighe, W. (Plasma Physics Lab., Princeton Univ., Princeton, NJ (US)); Dicicco, D. (Princeton X-ray Laser, Inc., and the Plasma Physics Lab., Princeton Univ., Princeton, NJ (US)); Suckewer, S. (Mechanical Aerospace Engineering Dept. and the Plasma Physics Lab., Princeton Univ., Princeton, NJ (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 512-519(Oct 1988).

The authors present two approaches to X-ray laser development at Princeton and review progress toward the wavelength region below 10 nm. In addition, they present the first results from the application of the existing soft X-ray laser at 18.2 nm to X-ray microscopy.

15681 **Radiation cooling rates of a selenium plasma.** Whitney, K.G. (Plasma Physics Div. of the Naval Research Lab., 4555 Overlook Ave., S.W., Washington, DC (US)); Coulter, M.C. (Berkeley Associates, P.O. Box 852, Springfield, VA (US) (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 552-559(Oct 1988).

The development of a scalable hydrogenic ionization model is described. The model utilizes correct energy and level structure data for each ionization stage and can be coupled self-consistently to a radiation transport calculation of the full nonhydrogenic X-ray spectrum. Thus it can be used to accurately calculate the effects of opacity on radiation emission rates that are of relevance to plasmas designed to produce recombination pumped population inversions due to rapid plasma cooling. The model is applied to a selenium plasma. The authors find that, at ion densities where X-ray lasing has been observed, line emission from Δn not equal to O transitions is a more important contributor to selenium's cooling rate than line emission from the Δn = O transitions. Plasma opacity can also play an important role.

15682 **Recombination lasing in heliumlike silicon.** Apruzese, J.P.; Kepple, P.C.; Davis, J. (Plasma Radiation Branch, Plasma Physics Div., Naval Research Lab., Washington, DC (US)); Pender, J. (Berkeley Research Associates, Inc., Springfield, VA (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 529-533(Oct 1988).

A major goal of current X-ray laser research is the achievement of gain in the 23.3 A-43.7 A wavelength region, known as the "water window." Silicon is the lowest atomic number element for which all the heliumlike 3-2 transitions lie in this region. The authors examine the fundamental kinetics of recombination lasing in this species and conclude that the Si XIII 1s3d/sup 1/D/sub 2/-1s2rho/sup 1/P/sub 1/ line at 39.1 A is an attractive candidate for recombination-pumped lasing. Attainment of gain in this line is somewhat more energetically favorable than for the hydrogenic Al XIII 3-2 transitions, but radiative trapping may be somewhat more troublesome than for H-like Al.

15683 **Room temperature near-infrared tunable Cr:La/sub 3/Ga/sub 5/SiO/sub 14/ laser.** Lai, S.T.; Chai, B.H.T.; Long, M. (Allied-Signal, Inc., Morristown, NJ 07960 (US)); Shinn, M.D. (Lawrence Livermore National Lab., Livermore, CA 94550 (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 9, 1922-1926(Sep 1988).

Laser operation was achieved in a new Cr-doped crystal La/sub 3/Ga/sub 5/SiO/sub 14/. The laser had a free-running wavelength of 960 nm at room temperature, and the laser was tunable from 862 to 1107 nm. Up to 80 mW output power has been measured with 1.5 W of pump power absorbed from a krypton ion laser. The /sup 4/T/sub 2/ fluorescence spectrum showed a peak at 890 nm indicating an unusually large Franck-Condon shift. At room temperature the fluorescence lifetime was 5.3 μs and the fluorescence quantum yield was measured to be about 14 percent.

15684 **Short and ultrashort wavelength lasers; Proceedings of the Meeting, Los Angeles, CA, Jan. 14, 15, 1988.** Jones, C.R. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1988). 193p. (CONF-8801144—).

From Short and ultrashort wavelength lasers meeting; Los Angeles, CA, USA (14 Jan 1988).

Various papers on short and ultrashort wavelength lasers are presented. The topics addressed include: pulsed-power driven, photopumped X-ray laser research at the Naval Research Laboratory; X-ray laser studies at LLE; toward shorter wavelengths for soft X-ray lasers based on lithiumlike ions; imploding coaxial krypton gas puffs as a potential X-ray laser; gain optimization and saturation of the Xe III 109 nm Auger laser; multiphoton double ionization of barium; soft X-ray FEL using a two-beam elliptical pill-box wakefield cavity; and spectra of highly ionized atoms. Also discussed are: progress in the gamma-ray laser program at Texas; nuclear transitions induced by atomic excitations; nuclear structure of the proposed gamma-ray laser candidate nucleus Re-186; conversion-electron experiment to characterize the decay of the Np-237 shape isomer; Mossbauer effect experiments applicable to GRASERS; overview of pulsed premixed short wavelength chemical laser concepts; hybrid chemical/excimer laser concept; isocyanic acid as a laser fuel.

15685 **Nuclear structure of the proposed gamma-ray laser candidate nucleus Re-186.** Madland, D.G.; Strottman, D.D. pp 103-108 of Short and ultrashort wavelength lasers; Proceedings of the Meeting, Los Angeles, CA, Jan. 14, 15, 1988. Jones, C.R. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1988). (CONF-8801144—).

From Short and ultrashort wavelength lasers meeting; Los Angeles, CA, USA (14 Jan 1988).

The results of theoretical nuclear structure model calculations for the gamma-ray laser candidate nucleus Re-186 are reported. The calculation of the orbitals and the matrix elements of the attractive residual in neutron-proton interaction is described. The phenomenological spin-dependent surface and volume delta function potentials are used to represent the interaction. The sensitivity of the calculated low-excitation level structure of Re-186 to the strength of these potentials is examined. Calculated Re-186 energy levels are presented and compared with experiment. The results show that Re-186 can be eliminated as a candidate for a gamma-ray laser. 17 references.

15686 **Overview of pulsed premixed short wavelength chemical laser concepts.** Bar, I.; Heflinger, D.; Kaufman, Y.; Sapir, M.; Temkin, A.YA. pp 136-141 of Short and ultrashort wavelength lasers; Proceedings of the Meeting, Los Angeles, CA, Jan. 14, 15, 1988. Jones, C.R. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1988). (CONF-8801144—).

From Short and ultrashort wavelength lasers meeting; Los Angeles, CA, USA (14 Jan 1988).

Some of the mixing and quenching problems encountered in previous efforts to obtain short-wavelength (less than 1 micron) laser radiation via chemical excitation are discussed, and a novel approach based on a premixed fuel-lasant capable of bypassing these problems is described. Preliminary results obtained by detonation of lead azide are presented. Calculations based on a coupled hydrodynamic-kinetic model show that the detonation should result in population inversion between potential laser levels of lead atoms. 16 references.

15687 **Photochemical production of NO(A 2Sigma+) in mixtures of HN_3 and O_3.** Neumann, D.K.; Coombe, R.D.; Ongstad, A.P.; Srech, D.J. pp 142-148 of Short and ultrashort wavelength lasers; Proceedings of the Meeting, Los Angeles, CA, Jan. 14, 15, 1988. Jones, C.R. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1988). (CONF-8801144—).

From Short and ultrashort wavelength lasers meeting; Los Angeles, CA, USA (14 Jan 1988).

A model has been developed which explains the production of NO(A) in mixtures of oxygen atoms and HN_3 over a wide range of O atom and HN_3 concentrations. O(1D) gas kinetically reacts with HN_3, abstracting the H atom and producing an N_3 radical. Subsequent reactions of both O(1D) and O(3P) with the N_3 radical produce NO(A). As expected, the rate constant for the O(1D) reactions is significantly larger than the rate constant for the O(3P) reaction. If estimates of unity yield of NO(A) from the O(3P) azide radical reaction are correct, a similar yield should occur for the exothermic, spin-allowed O(1D) azide radical reaction. A large yield coupled with the large reaction rate constants suggests the possibility of an NO(A) chemical laser, provided that a suitable chemical source of O(1D) can be found. 15 references.

15688 **Photopumped short wavelength lasers in xenon and krypton.** Kapteyn, H.C.; Falcone, R.W. pp 66-72 of Lasers '87; Proceedings of the Tenth International Conference on Lasers and Applications, Lake Tahoe, NV, Dec. 7-11, 1987. Duarte, F.J. McLean, VA; STS Press (1988). (CONF-871254—).

From Lasers '87: 10th international conference on lasers and applications; Lake Tahoe, NV, USA (7 Dec 1987).

Studies of short-wavelength lasers in Xe III at 108.9 nm and in Kr III at 90.7 nm are reported. The inversion mechanism in these systems is inner-shell photoionization, followed by selective Auger decay. Data presented include the demonstration of gain and the measurement of the upper and lower level natural lifetimes of the laser transitions. Computer models used to simulate the output of the gain demonstration experiments are discussed. These simple models can explain the observed output, without need to consider any effects other than amplified spontaneous emission on the dynamics of the system. 11 references.

15689 **Radiation effects on nuclear pumped laser optics.** Miley, G.H.; Chapman, R.; Nadler, J.; Williams, W. pp 249-256 of Lasers '87; Proceedings of the Tenth International Conference on Lasers and Applications, Lake Tahoe, NV, Dec. 7-11, 1987. Duarte, F.J. McLean, VA; STS Press (1988). (CONF-871254—).

From Lasers '87: 10th international conference on lasers and applications; Lake Tahoe, NV, USA (7 Dec 1987).

Transient, radiation-induced absorption in fused silica (type III) at 325 nm and in Pyrex at 633 nm has been investigated. The alpha for fused silica reaches a maximum value of 0.0070/cm during a 0.5 MRad reactor pulse and then decreases to 0.0001/cm at a time of 1000 s after the pulse. This corresponds to a recovery of 99 percent. The alpha for Pyrex reaches a maximum value of 0.58/cm, during a 0.5 MRad reactor pulse and then decreases to 0.11/cm at a time 1000 s after the pulse, corresponding to a recovery of 81 percent. The recovery of alpha in fused silica decreases with increasing dose. The maximum radiation-induced absorption for Pyrex during pulsed irradiation decreases dramatically with increasing temperature. The value of alpha(max) decreases over an order of magnitude as the irradiation temperature increases from room temperature to 450 C. The alpha for Pyrex recovers to a greater extent and much faster as the temperature increases. 11 references.

15690 **Ultrastable carbon dioxide (CO_2) lasers.** Freed, C. pp 468-477 of Lasers '87; Proceedings of the Tenth International Conference on Lasers and Applications, Lake Tahoe, NV, Dec. 7-11, 1987. Duarte, F.J. McLean, VA; STS Press (1988). (CONF-871254—).

From Lasers '87: 10th international conference on lasers and applications; Lake Tahoe, NV, USA (7 Dec 1987).

This paper reviews the spectral purity, frequency stability and long-term stabilization of CO_2 isotope lasers developed at MIT Lincoln Laboratory. Extremely high spectral purity and short-term stability of less than 1.5 x 10 to the -13th have been achieved and are discussed. A long-term stabilization technique, which was used to line-center lock any regular or hot-band CO_2 isotope laser transition, is described. A brief description on using CO_2 lasers as secondary frequency standards is also given. 15 references.

15691 **Progress report on the Lawrence Livermore National Laboratory soft x-ray laser program.** Brown, S.; Campbell, E.M.; Ceglio, N.; Eder, D.; Gaines, D.; Hawryluk, A.; Keane, C.; London, R.; MacGowan, B.; Matthews, D. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of X rays from laser plasmas. Richardson, M.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708233—).

From X-rays from laser plasmas; San Diego, CA, USA (19 Aug 1987).

Significant progress toward the goal of producing high power, high coherence x-ray lasers has been made. Lasing at wavelengths as low as 66 A has been achieved in a nickel like laser scheme which is scalable to sub-44 A wavelengths. In addition, x-ray laser cavities, x-ray holography, and an applications beamline have been demonstrated.

15692 **Liquid crystal devices for laser systems.** Jacobs, S.D. (Lab. for Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

Liquid crystals offer new opportunities for the fabrication of optical devices for laser applications. The fluid-like nature of monomeric materials provides for a large clear aperture capability with excellent optical quality, while the rigid nature of polymeric materials promotes environmental stability in a free-standing film. Because of their natural birefringence, liquid crystals can be used in situations where anisotropic crystalline solids are not available. Suitable applications include their use a spolarizers, retarders, notch filters, Solc or Lyot filters, Kerr effect shutters, nonlinear frequency converters, and nonlinear optical elements.

15693 **KRF lasers for fusion.** Center, R.E. (Spectra Technology, Inc., 2755 Northup Way, Bellevue, WA (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

Recently, there has been renewed interest in KrF lasers as drivers for the inertial confinement Fusion (ICF) program. This new interest is derived from recent development in KrF laser technology including: improved wall plug efficiency, reduced system complexity for megajoule drivers, and competitive cost levels. In this paper a review of the KrF laser technology in the late 1970's is presented; this review is followed by a description of the new developments that give reason for hope that these systems might become developed at fairly reasonable cost and size for the fusion application. These excimer laser systems are e-beam pumped and are scaleable, in principle, to large aperture size. This is essential because, for the ICF application, the authors need energies that are of the order of megajoules.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 14406, 14467, 15036

15694 **(BMU—1988-199) Description of the MOD2/85 version of the RALOG/FIPLOC family. Pt. 2. Physical modelling of thermal hydraulics and integration methods.** Jahn, H.; Hofer, E. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Mar 1988. 89p. (GRS-A—1426). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This report outlines all assumptions of the lumped parameter models, the resulting differential equation systems for saturated and superheated conditions, instationary flows of atmosphere or liquid fluid as well as all other equations used to describe stationary calculations or physical states and processes. The description of the integration method contains the explicit and implicit integration part (used for the thermal hydraulic model) and the integration of the heat slab conditions (which is handled separately from the fluid dynamics).

15695 **(CEA-CONF—9532) Second order scheme in bidimensional space for compressible gas with arbitrary mesh.** Forestier, A.J.; Gaudy, C.; Bung, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Compagnie Internationale de Services en Informatique (CISI), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jun 1988. 19p. (CONF-8806299—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756407/JAW.

From 11. International Conference on numerical methods in fluid dynamics; Hampton, VA, USA (27 Jun 1988).

Computational fluid dynamics (C.F.D.) is a large branch of scientific computing that lately undergone explosive growth. It draws upon elements from related disciplines, fluid mechanics, numerical analysis, computer science and computational geometry. So we want to describe a new bidimensional scheme for compressible flow in any complex geometry.

15696 **(EMR—1988) THERMECH TASC D-300. Thermal and mechanical design of shell and tube heat exchangers.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). [1988]. 44p. (CE—02291). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The capabilities of the THERMECH series of computer programs in the field of shell and tube heat exchanger design are presented in this document. The programs include a comprehensive thermal design program and complete mechanical design and drafting programs. The design program can be used to design the exchanger and its components, calculate the optimum size of exchanger to perform a given duty, verify if a given exchanger size would perform a specified duty, and simulate the performance of a given exchanger under specified conditions. Design can be performed according to a number of national codes and standards. The other programs can be used to prepare bills of materials, customized engineering drawings of the entire exchanger and of each component, and note sheets providing information such as specifications, testing and inspection requirements, and instructions on alignment and weld quality. 22 figs.

15697 (INIS-mf—11348, pp 62) **Evaluation of internal leaks in double current heat exchangers.** Ramirez G, F.P.; Cortes I, M.E.; Cayetano C, J.; Sanchez P, R.; Sanchez, V.T.; Celis, M.T.; Godinez, A. (Instituto Mexicano de Petroleo, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15698 **(K/ETAC—80) Determination of local fluid drag by a laser heating/thermographic phosphor technique: Applicability of the H. Ludwieg model.** Keyes, J.J. Jr.; Sartory, W.K. (Oak Ridge National Lab., TN (USA)). Nov 1988. Contract AC05-84OR21400. 9p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006462/JAW.

A new application of laser thermography, that utilizes local heat- transfer measurements to deduce local fluid-induced drag is proposed and analyzed. The analytical model originally developed by H. Ludwieg is extended to account for heat conduction in the wall, and the limitations in Reynolds number that correspond to the Ludwieg assumption of a thin thermal boundary layer for air and water are discussed. 2 figs., 3 tabs.

15699 **(N—89-12028) Fluid spray simulation with two-fluid nozzles.** Ingebo, R.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 14p. (NASA-TM—101367; E—4406; NAS—1.15:101367; AIAA—89-0053; CONF-890123—). NTIS, PC A03/MF A01.

From 27. AIAA aerospace sciences meeting; Reno, NV, USA (9 Jan 1989).

Two-phase interacting flow inside a two-fluid fuel atomizer was investigated and a correction of aerodynamic and liquid-surface forces with characteristic drop diameter was obtained for liquid-jet breakup in Mach 1 gas flow. Nitrogen gas mass-flux was varied from 6 to 50 g/sq cm sec by using four differently sized two-fluid atomizers with nozzle diameters varyig from 0.32 to 0.56 cm. The correlation was derived by using the acoustic gas velocity, V sub c, as a basic parameter in defining and evaluating the dimensionless product of the Weber (We) and Reynolds (Re) numbers. By using the definition of WeRe, it was found that the ratio of orifice diameter to Sauter mean drop diameter could be correlated with the dimensionless ratio WeRe and the gas to liquid density ratio.

15700 (N—89-12582, pp 409-415) **Heat pipe cooling system with sensible heat sink.** Silverstein, C.C. 1988. NTIS, PC A21/MF A01. (NASA-CP—3015; REPT—88B0253; NAS—1.55:3015; CONF-8810291—).

From 15. space simulation conference: support the highway to space through testing; Williamsburg, VA, USA (31 Oct 1988).

A heat pipe cooling system which employs a sensible heat sink is discussed. With this type of system, incident aerodynamic heat is transported via a heat pipe from the stagnation region to the heat sink and absorbed by raising the temperature of the heat sink material. The use of a sensible heat sink can be advantageous for situations where the total mission heat load is limited, as it is during re-entry, and a suitable radiation sink is not available.

15701 **(N—89-12838) Influence of bulk turbulence and entrance boundary layer thickness on the curved duct flow field. Final contractor report.** Crawford, R.A. (Tennessee Univ., Tullahoma (USA). Space Inst.). Nov 1988. 88p. (NASA-CR—4188; E—4458; NAS—1.26:4188; UTSI—88-07). NTIS, PC A05/MF A01.

The influence of bulk turbulence and boundary layer thickness on the secondary flow development in a square, 90 degree turning duct was investigated. A three-dimensional laser velocimetry system was utilized to measure the mean and fluctuating components of velocity at six cross-planes in the duct. The results from this investigation, with entrance boundary layer thickness of 20 percent, were compared with the thin boundary layer results documented in NASA CR-174811. The axial velocity profiles, cross-flow velocities, and turbulence intensities were compared and evaluated with regard to the influence of bulk turbulence intensity and boundary layer thickness, and the influence was significant. The results of this investigation expand the 90 degree curved duct experimental data base to higher turbulence levels and thicker entrance boundary layers. The experimental results provide a challenging benchmark data base for computational fluid dynamics code development and validation. The variation of inlet bulk turbulence intensity provides additional information to aid in turbulence model evaluation.

15702 **(NP—9770216) Prediction of trajectories of a jet issuing normally across a wall boundary layer into a cross flow (an analysis based on a vortex filament model).** Sugiyama, Yoshiyuki. (Nagoya Univ. (Japan)). (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.); Nagoya Univ. (Japan)). Dec 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770216/JAW.

An increase in jet penetration due to the wall boundary layer is estimated quantitatively in the flow field including an aerodynamic interference between the wall boundary layer and the jet. The aerodynamic effect of the wall boundary layer is replaced by that of a secondary vortex filament resulting from vorticity in the wall boundary layer. A differential equation governing the increase in jet penetration is derived using the circulation around the secondary vortex filaments, its induced velocity and the empirical decay law of the maximum velocity along the jet center-line. The circulation around the secondary vortex filament is estimated according to Hawthorne's theory and expressed in terms of aerodynamic characteristics of the wall boundary layer. A numerical example of the present analysis shows a fairly good agreement with the experiment. This indicates that the used flow model simulates the real flow conditions well.

15703 **Entrainment and pull-through phenomena at a tee junction.** Anderson, J.L. New York, NY; American Institute of Chemical Engineers (1987). 25p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 12SF.

Results from a series of experiments investigating the phenomena of liquid entrainment and vapor pull-through at a tee junction between a horizontal pipe and a small branchline are presented. These experiments were performed under conditions of stratified steam-water flows at 3.4, 4.4, and 6.2 MPa in the mainline, and critical flow through a nozzle installed in the branchline. Two orientations of the branchline were investigated: horizontal and vertical downflow. Results from the experiments are discussed, and there are recommended correlations for predicting levels at which the onset of vapor pull-through and liquid entrainment occur, and for predicting flow quality into the branchline.

15704 **Mapping the "states" of vibrated beds.** Thomas, B.; Mason, M.O.; Liu, Y.A.; Squires, A.M. New York, NY; American Institute of Chemical Engineers (1987). 37p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 52E.

Particulate beds on a surface vibrating at about 25 Hetz with an amplitude of a few millimeters display a variety of "states": freely bouncing particles obeying simple Newtonian mechanics; a first "coherent-expanded state" in which particles move together in loosely organized packets to form a turbulent shallow layer; a second "coherent-condensate state", either beneath or replacing the first, in which particles move together in a compacted layer, neighboring particles tending to remain in close company. Which of these states are present, and whether a gap forms beneath the bed, depend upon bed height and particle and gas properties. Results of observations of transitions between states are summarized in terms of dimensionless parameters.

15705 **Interactions of resonances and global bifurcations in Rayleigh-Benard convection.** Kevrekidis, I.G.; Ecke, R.E. New York, NY; American Institute of Chemical Engineers (1987). 23p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 64H.

The authors present detailed two-parameter experimental studies of the interaction of resonances in the quasiperiodic regime of low aspect ratio Rayleigh Benard convection. The system exhibits generic characteristics of two-parameter families of maps of the plane, including global manifold interactions, whose effects on the system dynamics are observed and explained. This work constitutes an indirect proof of low-dimensional chaotic behavior in distributed physical systems, and provides a model case of coexisting spatial coherence with temporal disorder (deterministic chaos) in fluid dynamics.

4205 Materials Testing

REFER ALSO TO CITATION(S) 14549, 14550, 15126, 15160, 15275, 15420

15706 **(ANL—87-53) Development of nuclear magnetic resonance (NMR) imaging technology for advanced ceramics.** Ellingson, W.A.; Ackerman, J.L.; Garrido, L.; Wong, P.S.; Gronemeyer, S. (Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 51p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006400/JAW.

In the work described in this report, we have explored both solid- state NMR imaging to map the distribution of binder/plasticizers (B/Ps) in cold-pressures ceramic parts and solution NMR to image the open, i.e., surface-connected porosity in dewaxed parts.

(Knowledge of the distribution of this porosity also gives us an idea of how uniform the density of the final part will be.) The ability to detect B/Ps was initially evaluated on a state-of-the-art 1.5-T medical imager (Siemens Magnetom{trademark}) with T_1-weighted imaging techniques and a 10-cm standard eye coil. However, this system did not provide adequate image resolution. One problem is that at room temperature the waxy ("soft-solid") B/Ps have spin-spin relaxation times (T_2s) of {approximately}1 msec using spin-echo, phase-encoding techniques. Short T_2s imply long data acquisition times. We solved this problem by designing a special NMR probe for a 2-T, small-bore ({approximately}15 cm) superconducting magnet system. The special NMR probe, designed and built with field gradients of {approximately}10 gauss/cm, has the ability to image material with $T_2 < 2$ msec by means of spin-echo phase-encoding techniques. Si_3N_4, SiC, and Al_2O_3 specimens, up to 25 nm in diam and containing various concentrations of B/P (2.5--15.5 wt %), were imaged with a spatial resolution of {approximately}300 μm. Thus, we demonstrated that NMR imaging has the potential to map the distribution of organic B/Ps. The initial results show that a medical system may not be able to detect B/Ps unless elevated temperatures are used, whereas experimental small-bore systems with higher field gradients and shorter switching times detect B/P distribution quite well. 25 refs., 31 figs., 4 tabs.

15707 **(CEA-tr—2268) Neutron radiography track detection systems.** Smirnov, V.P.; Klochkov, E.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1987. 25p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756434/JAW.

Sensitivity of neutron converters, recording efficiency and optical properties of particle track detectors for neutron radiography are studied in this paper. Cellulose nitrate and cellulose triacetate films are used for alpha particles, Lavsan, boron glass and mica for fission tracks. Samples are irradiated by a plutonium-uranium alloy and a californium source and optical density is determined. Good performance is obtained with Lavsan and uranium 235 converter. 3 tabs., 8 figs., 5 refs.

15708 **(CEA-tr—2269) Influence of neutron energy spectra on the quality of neutron radiographs of fuel elements.** Klochkov, E.P.; Smirnov, V.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1987. 19p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756435/JAW.

Fuel element image is mainly formed by neutrons with an energy up to 0.5 eV. Radiograph improvement requires increased contribution of thermal neutrons or use of appropriate converters decreasing background noise. Images obtained with a neutron beam from a reactor and a californium source are compared. 7 figs, 1 tab., 5 refs.

15709 **(CONF-890219—1) Eddy current inspection of ferromagnetic materials using pulsed magnetic saturation.** Dodd, C.V.; Deeds, W.E.; Chitwood, L.D. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005339/JAW.

From International conference on fossil power plant rehabilitation: trends in life management and reliability technology; Cincinnati, OH, USA (27 Feb 1989).

A pulsed eddy-current system has been designed and developed for nondestructive evaluation of ferromagnetic steam generator tubing from the bore side. A large current pulse is sent through a driver coil to produce magnetic saturation all the way through the wall of a tube. A pickup coil monitors the field produced by the driver coil and produces a pulse whose shape is dependent on the electromagnetic properties of the tube as well as the driving pulse. The output pulse heights at selected times are used as data that are computer-correlated with calibration data taken from machined standards. The magnitude and length of the pulse can be increased to saturate thicker tubes, or shortened for very thin sections of ferromagnetic materials. Tube walls 5 mm thick have been tested with pulses of 500 kw peak power and tubes 0.2 mm thick have been tested with 400 watt pulses. Advanced pulsed instruments are set up entirely with signals from a controlling computer sent over the IEEE-488 bus, which then transmits the data back to the computer. The controlling computer, which may be either a PC-AT or a IBM System 9000, can analyze, display and store the data in real time. The system has demonstrated the capability to detect small flaws located near the outside of thick ferromagnetic tubing in the presence of other artifacts on the tube outside diameter. 2 refs., 10 figs.

15710 **(CONF-8811134—1) Effects of temperatures and weighting functions on NMR characteristics of short T_2 materials.** Wong, Ping S.; Ellingson, W.A. (Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004281/JAW.

From 74. scientific assembly and annual meeting of the Radiological Society of North America (RSNA); Chicago, IL, USA (27 Nov 1988).

Proton nuclear magnetic resonance spectroscopy and imaging have been evaluated as a nondestructive characterization method for studying semi-solid proprietary organic polymers. To increase the characteristic short (<5 ms) T_2's of these materials, elevated-temperature techniques were explored. A two-dimensional spin-echo RF pulse sequence was used with a TE of 4--5 ms and no slice selection to obtain images with a surface coil. To maximize the low intrinsic S/N ratio, the various weighting functions were used to process acquired data; the effects of these functions are described. 13 refs., 9 figs.

15711 **(DOE/ER/45253—4) Optical second harmonic generation in metal monolayers and metal surfaces.** Furtak, T.E.; Miragliotta, J. (Colorado School of Mines, Golden (USA). Dept. of Physics). 1988. Contract FG02-86ER45253. 3p. (CONF-881002—45). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006123/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Information about the structure of foreign metal monolayers can be obtained through measurements of the polarization dependence of optical second harmonic generation. We have used this phenomenon to monitor electrochemically controlled deposition of hexagonal metals on the (111) face of Ag. In the process, we have learned more about resonant second harmonic effects involving intrinsic excitations of the monolayer as well as surface influences within the Ag substrate. 9 refs.

15712 **(FhG-IzfP—860139-TW) Adaptation, testing and application of the two-dimensional FE computer program system for steam generator tube testing.** Betzold, K. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 12 Mar 1987. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756803/JAW.

The 2d-FE computing program system, taken over by EPRI, is used for the improvement of the eddy current test of steam generator heating tubes. The investigations focus on test tasks in the area of the tube plate and the scrap mark; among them: accumulation of mud in the cracking area and above the tube plate; circulating slots with and without accumulation of mud. The interaction of the factors of influence given by the test object and the parameters selectable by the tester as for example coil length and base space for absolute coils and differential coils as well as test frequencies are calculated and the form of the signal locus curves and the dynamic curves are listed in a sample catalogue. It is demonstrated with selected examples that the sample catalogue contributes to the test-specific design of the coil and to the choice of the test frequencies; interpretation of measured signals; deepening of the knowledge of the physical processe in eddy current tests.

15713 **(FRCEA-TH—173) Detection methods of pulsed X-rays for transmission tomography with a linear accelerator.** Glasser, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique; Grenoble-1 Univ., 38 (France)). Jul 1988. 277p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88756877/JAW.

Appropriate detection methods are studied for the development of a high energy tomograph using a linear accelerator for nondestructive testing of bulky objects. The aim is the selection of detectors adapted to a pulsed X-ray source and with a good behavior under X-ray radiations of several MeV. Performance of semiconductors (HgI/sub 2/, Cl doped CdTe, GaAs, Bi/sub 12/Ge0/sub 20/) and a scintillator (Bi/sub 4/Ge/sub 3/0/sub 12/) are examined. A prototype tomograph gave images that show the validity of detectors for analysis of medium size equipment such as a concrete drum of 60 cm in diameter.

15714 (N—89-12626, pp 661-671) **High pressure, high temperature hydrogen environment for metals properties testing system.** Rother, M.J. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

The use of materials in an adverse environment is always a concern of design engineers. The additional constraints of today's aerodynamic requirements, especially high strength-to-weight ratios for engineering components, have increased the necessity for detailed information of the environmental effects on material properties. The MTS system designed and is in the process of manufacturing a test system for NASA-MSFC to evaluate the effects of high pressure, high temperature hydrogen gas on the material properties of metals. The design process for the system is discussed with a presentation of the system's final configuration.

15715 **Development of the electromagnetically launched expanding ring as a high-strain-rate test technique.** Gourdin, W.H.; Weinland, S.L.; Boling, R.M. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94551). *Review of Scientific Instruments;* **60**: No. 3, 427-432(Mar 1989).

Improvements to the electromagnetically launched expanding ring experiment that make the technique more reproducible, analyzable, and amenable to the rapid testing of many specimens are presented. Aspects of the design and containment of the primary solenoid, high-voltage switching, and electromagnetic diagnostics are discussed, and a new method for launching specimens of low conductivity is described. The reproducibility of the method is demonstrated for oxygen-free electronic (OFE)copper and tantalum rings.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 15457, 15846

15716 **(DOE/ER/13939—1) Model building and control of large scale systems: [Progress report].** Basar, T.; Kokotovic, P.V. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). 17 Jan 1989. Contract FG02-88ER13939. 6p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006823/JAW.

This report provides a brief review of progress for the first six months of the three-year research project "Model Building and Control of Large Scale Systems," supported by a grant (No. FG02-88ER13939) from the Department of Energy. It also includes the budget for the second year of the grant. 4 refs.

15717 **(SAND—88-1967C) Symbols for communication circuit design and documentation.** George, M.; Pierson, L.G.; Witzke, E.L. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 11p. (CONF-890314—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE88013002/JAW.

From Phoenix conference on computers and communications; Scottsdale, AZ, USA (22 Mar 1989).

A set of communication symbols has been developed at Sandia National Laboratories for designing and documenting communication circuits. The symbols can depict devices in a circuit, show proper interfacing of devices, and show the propagation of clocks, data, and control signals through the circuit. This paper defines the communication symbols and illustrates their usage. 3 refs., 6 figs.

15718 **(SAND—88-2162) Mechanisms for the operation of a laser-triggered vacuum switch.** Brannon, P.J.; Riley, M.E. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007059/JAW.

A new model for the operation of a laser-triggered vacuum switch utilizing a composite target pellet in the cathode is given along with supporting experimental results. It is shown that two separate mechanisms are responsible for the operation of the switch, namely, one mechanism for the initial current and a separate mechanism for the current buildup. 4 refs., 8 figs.

15719 **(SAND—88-2506) Comparison of an ac and a dc bridge for standard platinum resistance thermometer calibrations.** Odom, M.K. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007060/JAW.

The Primary Standards Laboratory (PSL) presently uses a manually operated dc bridge to calibrate standard platinum resistance thermometers (SPRTs). The PSL will replace the dc bridge with a computer controlled ac bridge. The two bridges are compared for calibrating SPRTs. The results show that the two bridges are interchangeable within <3m{degree}C in the PSL environment. 5 refs., 9 figs., 7 tabs.

15720 **Dual dielectric silicon metal-oxide-semiconductor field-effect transistors as radiation sensors.** Hughes, R.C.; Dawes W.R. Jr.; Meyer, W.J.; Yoon, S.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 5, 1972-1976(1 Mar 1989).

A new design for radiation-sensing field-effect transistors (RADFETs) is presented, involving the use of very thick silicon nitride layers deposited on top of a high-quality thermal silicon dioxide. In contrast to previous RADFET fabrication procedures, no attempt was made to introduce hole traps into the thermal oxide. Instead the trapping layer at the nitride oxide interface was used to store the positive charge which forms the basis for operation of the RADFET. Data is presented which shows hole transport in the thermal oxide. Models explaining the field dependence of the response and the saturation behavior of the dual dielectric device are given. These RADFETs are more stable than any previously described in the literature and have a sensitivity of 86 μV/rad dose at room temperature.

15721 **Developing a total-dose radiation screen for silicon-on-insulator MOS transistors.** Fleetwood, D.M.; Tsao, S.S.; Winokur, P.S. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the Electrochemical Society Spring meeting: Extended abstracts. Volume 88-1. Pennington, NJ; The Electrochemical Society (1988). (CONF-880549—).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

A prime motivating factor to develop silicon-on-insulator (SOI) metal-oxide-semiconductor (MOS) integrated circuit (IC) technologies is their increased impurity to transient radiation and single-event upset, as well as total immunity to "latchup." However, SOI ICs are at least as sensitive to total-dose ionizing radiation as bulk ICs. Therefore, to ensure that the desired total-dose radiation hardness is properly designed and built into SOI MOS devices, it is important to develop reliable quick-turnaround, total-dose radiation screens for SOI transistors and circuits. Defining such a screen involves characterizing the unique response of SOI devices to different radiation sources, dose rates, and radiation and test bias conditions. In this summary the authors focus on what ra-

diation source(s) should be used for evaluation of SOI process lot radiation hardness. The de facto standard for radiation hardness assurance testing is exposure of packaged parts to Co-60 gamma radiation. Lately, it has been suggested that a 10-keV x-ray source could be used to irradiate devices at the wafer level. This technique has practical advantages over Co-60 irradiations. Because irradiations are performed at the wafer level, information can be gained immediately after fabrication without the added delay and expense involved in packaging devices. In this summary, the authors compare x-ray and Co-60 irradiations of SIMOX and ZMR SOI MOS transistors. Front gate, sidewall, and backgate responses are examined. These results should facilitate material and process optimization efforts to improve the hardness of SOI devices.

15722 **Advanced joint test assembly (JTA) telemetry system.** Stimmell, K.G. (Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of the international telemetering conference. Volume XIII. Research Triangle Park, NC; Instrument Society of America (1987). (CONF-8710171—).

From International telemetering conference; San Diego, CA, USA (26 Oct 1987).

The authors design telemetry systems which instrument weapons in the Joint DoD/DOE flight test program. These telemetry systems gather data which can be used to determine if a weapon functioned as intended. The authors are designing a telemetry system to support new programs for the next decade and to replace old telemetry systems which can no longer be produced. This multi-system Joint Test Assembly (JTA) is being designed to be modular, flexible, and testable. New techniques for increasing reliability, such as redundancy, error detection and correction, and microprocessor recovery will be employed. The requirements for each program can be met by choosing the necessary circuitry from a "shopping list" and packaging to meet the mechanical constraints for each system. Production specifications and test equipment will be in place to support any telemetry which is composed of the previously-designed modules. Modifications of hardware and software to support individual requirements will be kept to a minimum. The authors expect this new approach to telemetry system development to significantly reduce cost and lead time for every program on which it is employed. The use of this telemetry system on multiple programs should also enhance reliability.

15723 **A new method for measuring waveguide propagation losses.** Brannon, P.J. (Sandia National Labs., Albuquerque, NM (US));. pp v of Integrated optical circuit engineering V. Mentzer, M.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708241—).

From Integrated optical circuit engineering V; San Diego, CA, USA (17 Aug 1987).

The authors report a refinement of a previously reported method for measuring propagation losses in single-mode optical waveguides. The method as previously described applies to isotropic materials (glass); corrections are necessary when anisotropic materials, such as LiNbO/sub 3/ are used. This report describes the method and indicates two means for estimating the corrections for anisotropic materials.

15724 **Low loss optical waveguides by direct Ti ion implantation in LiNbO/sub 3/.** Ashley, P.R.; Buchal, C. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Integrated optical circuit engineering V. Mentzer, M.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708241—).

From Integrated optical circuit engineering V; San Diego, CA, USA (17 Aug 1987).

The maximum Ti concentration and corresponding Δn as well as the minimum waveguide size is limited in diffused waveguides by the diffusion coefficient. Ion implantation offers an interesting alternative with a clear advantage at larger wavelengths for smaller waveguide cross-sections. Both planar and channel waveguides have been fabricated by ion implantation of Ti into a LiNbO/sub 3/ substrate. A solid phase epitaxial regrowth of the implant induced crystal damage resulted in excellent waveguides with propagation losses of less than 1 db/cm. Guide depth of less than 1 micron and Δn of 0.04 have been achieved. Fabrication techniques and optical properties of the waveguides are presented.

15725 **Optical multiplexer-demultiplexer for the photonic streak camera.** Del Castillo, H. Jr.; Jelsma, L.F. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of Integrated optical circuit engineering V. Mentzer, M.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708241—).

From Integrated optical circuit engineering V; San Diego, CA, USA (17 Aug 1987).

The authors present the results of their investigation of the feasibility of using an optical multiplexer-demultiplexer with diffraction gratings for the phototonic streak camera. They describe how grating can be used in a demultiplexer for a crystal streak camera and evaluate the performance of two gratings in a streak camera. The linear dispersion equation, used to determine the number of channels that can be multiplexed and recovered, accounts for focusing and collimating optics but neglects grating anomalies. To study the performance of the grating in the demultiplexer design, the authors investigated the characteristics of the gratings. The model reveals that interference from individual, adjacent, diffracted orders is a major restriction when one is recovering a large number of individual wavelengths from a beam containing a large spectral range. They include in this paper the experimental results that verify the model used to describe the multiplexer demultiplexer.

15726 **LiNbO/sub 3/:Ti directional-coupler modulators for high-bandwidth, single-shot instrumentation systems operating at 800 nm.** Lowry, M.; Jander, D.; Lancaster, G.; Kwiat, P.; McWright, G.; Peterson, R.T.; Tindall, W.; Roeske, F. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of Integrated optical circuit engineering V. Mentzer, M.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708241—).

From Integrated optical circuit engineering V; San Diego, CA, USA (17 Aug 1987).

The authors update their work on optical directional-coupler modulators (ODCMs) for single-shot, analog instrumentation systems operating at — 800 nm. They can now fabricate directional-coupler devices that have one input and two output pigtails with insertion losses of 8.9 dB on average. Data for the ODCMs indicate an impulse response of less than 40 ps. They have implemented these devices in an ultrafast, x-ray measurement system. They discuss our data from this implementation and their implications for continued ODCM development.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 14488, 16000

4210 Combustion Systems

REFER ALSO TO CITATION(S) 14267, 14270, 14271, 14273, 14275, 14489, 14491, 14492, 15157, 15158, 15166, 15167, 15168, 15169, 15266, 15267, 15269, 15604, 15605, 15606, 15607, 15608, 15931, 15944

15727 **(DOE/CS/66001—T2) Spray Combustion Modeling and Evaluation Task (formerly Direct Heating and Conversion Project): Final report, May 15, 1981--December 31, 1985.** Massier, P.F.; Bellan, J.; Gavalas, G.R. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Energy Conversion and Utilization Technologies Program). 17 Jan 1989. Contract AI01-81CS66001. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006478/JAW.

The purpose of the Energy Conversion and Utilization Technologies (ECUT) Program is to provide to industry the means to achieve higher energy efficiency and greater broad-specification fuel usage through expansion of the technology base and through the evolution of advanced concepts in energy conversion and utilization. The applied-research and exploratory-development activities supported under this program are of a long-term, high-risk nature

and focus on generic technologies which have potential for providing markedly increased energy productivity on diverse applications addressed by the broad spectrum of energy consumers. The Spray Combustion Modeling and Evaluation Task (formerly Direct Heating and Conversion Project) is one of several that comprise the Continuous Combustion work element of the ECUT Combustion Program. This program supports advanced technology and exploratory developments that will improve the energy-conversion efficiency, multiple-fuel use, and fuel flexibility of furnaces, boilers, stationary open-cycle heat engines, and plans the support of novel, direct energy-conversion systems. Fuels of interest are those that are not currently commercially significant and whose wider usage would conserve the supply of premium fuels such as oil and natural gas. 6 refs., 4 figs.

15728 **(DOE/NASA—0330-3) The effect of insulated combustion chamber surfaces on direct-injected diesel engine performance, emissions, and combustion.** Dickey, D.W.; Vinyard, S.; Keribar, R. (Southwest Research Inst., San Antonio, TX (USA)). Sep 1988. Contract AI01-86CE50162. 178p. (NASA/CR—182204; SWRI—8966). NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007283/JAW.

The combustion chamber of a single-cylinder, direct-injected diesel engine was insulated with ceramic coatings to determine the effect of low heat rejection (LHR) operation on engine performance, emissions, and combustion. In comparison to the baseline cooled engine, the LHR engine had lower thermal efficiency, with higher smoke, particulate, and full load carbon monoxide, emissions. The unburned hydrocarbon emission were reduced across the load range. The nitrous oxide emissions increased at some part-load conditions and were reduced slightly at full loads. The poor LHR engine performance was attributed to degraded combustion characterized by less premixed burning, lower heat release rates, and longer combustion duration compared to the baseline cooled engine. 33 refs., 67 figs., 7 tabs.

15729 (EMR—ER80-8F, pp 78-86) **Wood waste fuelled boilers.** Tartre, R. (Volcano, Inc., St. Hyacinthe, Que.). 1980. (In French). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN. (CONF-8004250—; MICROLOG—82-3707; CE—02117).

From Biomass energy seminar; Montreal, Canada (14 Apr 1980).

Five different models of wood waste boilers are described in outline form and illustrated. These include a firetube boiler able to burn cut pieces of 20% maximum moisture content for use by manufacturers of wood products (e.g. furniture); a firebox type boiler, able to burn waste of up to 45% moisture content, for use by plywood and parquet manufacturers; a natural-circulation water tube boiler, able to burn wastes of up to 53% moisture content, for use in paper mills, small communities, and so on; a forced circulation boiler; and a large water-tube boiler designed to be assembled onsite in paper mills for such purposes as cogeneration and process steam generation. 5 figs.

15730 (N—89-12626, pp 241-265) **Thermal analysis of SSME turbopump bearings.** Cody, J.C.; Marty, D.; Tiller, B.K. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

A lumped node thermal network model of the pump end bearing of the Space Shuttle Main Engine (SSME) was developed. The bearing elements, the shaft, isolator, housing, and cryogenic coolant flow characteristics are included. Two phase heat transfer characteristics of the LOX coolant are used in the model. Two computer codes, one thermal, and the other a bearing performance code, were coupled to provide an overall evaluation of the bearing operating characteristics. Software was developed to allow automatic iteration between the models until a compatible solution was found. The model was used to develop sensitivity characteristics for the pump and the bearing. A broad range of parameters such as contact friction, preload, heat transfer coefficient, coolant flow, subcooling, and outer race misalignments were investigated. In many cases, the solutions of the thermal and performance model would not agree indicating a thermally unstable operating conditions which leads to excessive bearing temperatures and possible failure. The results show that bearing component temperatures are very sensitive to contact friction, preloads and heat transfer coefficients. Although not as sensitive to coolant flow and subcooling, these parameters are very important for marginal conditions. In some cases, thermal instability could be induced by reducing flow or by raising coolant temperature to saturation.

15731 (N—89-12626, pp 474-528) **Liquid oxygen cooling of high pressure LOX/hydrocarbon rocket thrust chambers.** Price, H.G. Oct 1986. NTIS, PC A99/MF E03. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—).

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

An experimental program using liquid oxygen (LOX) and RP-1 as the propellants and supercritical LOX as the coolant was conducted at 4.14, 8.274, and 13.79 MN/sq m (600, 1200, and 2000 psia) chamber pressure. The objectives of this program were to evaluate the cooling characteristics of LOX with the LOX/RP-1 propellants, the buildup of soot on the hot-gas-side chamber wall and the effect of an internal LOX leak on the structural integrity of the combustor. Five thrust chambers with throat diameters of 6.6 cm (2.6 in) were tested successfully. The first three were tested at 4.14 MN/sq m (600 psia) chamber pressure over a mixture ratio range of 2.25 to 2.92. One of these three was tested over 22 cyclic tests after the first through crack from the coolant channel to the combustion zone was observed with no apparent metal burning or distress. The fourth chamber was tested at 8.274 MN/sq m (1200 psia) chamber pressure over a mixture range of 1.93 to 2.98. The fourth and fifth chambers were tested at 13.79 MN/sq m (2000 psia) chamber pressure over a mixture ratio range of 1.79 to 2.68.

15732 **(N—89-12876) Turbine engine hot section technology 1986.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1986. 488p. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—). NTIS, PC A21/MF A01.

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The Turbine engine hot section technology (HOST) Project of the NASA Lewis Research Center sponsored a workshop to discuss current research pertinent to turbine engine durability problems. Presentations were made concerning the hot-section environment and the behavior of combustion liners, turbine blades, and turbine vanes. The presentations were divided into six sessions: Instrumentation, Combustion, Turbine Heat Transfer, Structural Analysis, Fatigue and Fracture, and Surface Protection. Topics discussed included modeling of thermal and fluid-flow phenomena, structural analysis, fatigue and fracture, surface protective coatings, constitutive behavior of materials, stress-strain response, and life-prediction methods. Researchers from industry, academia, and government presented results of their work sponsored by the HOST project.

15733 (N—89-12876, pp 19-31) **HOST structural analysis program overview.** Thompson, R.L. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Hot-section components of aircraft gas turbine engines are subjected to severe thermal structural loading conditions, especially during the startup and takeoff portions of the engine cycle. The most severe and damaging stresses and strains are those induced by the steep thermal gradients induced during the startup transient. These transient stresses and strains are also the most difficult to predict, in part because the temperature gradients and distributions are not well known or readily predictable and, in part, because the cyclic elastic-viscoplastic behavior of the materials at these extremes of temperature and strain are not well known or readily predictable. A broad spectrum of structures related technology programs is underway to address these deficiencies at the basic as well as the applied level. The three key program elements in the HOST structural analysis program are computations, constitutive model-

ing, and experiments for each research activity. Also shown are tables summarizing each of the activities.

15734 (N—89-12876, pp 45-50) **HOST surface protection R and T overview.** Miller, R.A. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Most of the efforts in the HOST Surface Protection Subproject were focused on thermal barrier coating (TBC) life prediction. Also, a small effort, consisting primarily of wrapping up and reporting the work of previous years, remained on the airfoil deposition modeling. The work performed under the airfoil deposition modeling program element was concerned with modeling the deposition of corrodants onto turbine airfoils. Accomplishments included verification of the chemically frozen boundary (CFBL) theory. Encouraging results were also achieved with the recently developed local thermochemical equilibrium (LTCE) theory. The surface protection subprogram was devoted to thermal-barrier-coating life modeling. This modeling is an essential step in the development of TBC's.

15735 (N—89-12876, pp 51-60) **Further development of the dynamic gas temperature measurement system.** Elmore, D.L.; Robinson, W.W.; Watkins, W.B. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objective of this effort was to experimentally verify a dynamic gas temperature measurement system in laboratory experiments. The dynamic gas temperature measurement system verification program is described. A brief description of the sensor geometry and construction is followed by a discussion of the probe heat transfer analysis and subsequent compensation method. The laboratory experiments are described and experimental results are discussed. Finally, directions for further investigation are given.

15736 (N—89-12876, pp 61-68) **Laser anemometry: a status report.** Wernet, M.P.; Seasholtz, R.G.; Weikle, D.H.; Oberle, L.G. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

A laser anemometer system is being developed for the warm turbine facility as part of the HOST program. The system will be built using results obtained from the analytical and experimental research program. The status report of the laser anemometry applications research effort is presented. The designs for the turbine casing, the windows, and the positioning system were completed. A block diagram of the laser anemometer system, signal processing scheme, and computer system is given.

15737 (N—89-12876, pp 69-84) **Elevated temperature strain gages.** Brittain, J.O.; Geslin, D.; Lei, J.F. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

One of the goals of the HOST Program is the development of electrical resistance strain gages for static strain measurements at temperatures equal to or greater than 1273 K. Strain gage materials must have a reproducible or predictable response to temperature, time and strain. It is the objective of this research to investigate criteria for the selection of materials for such applications through electrical properties studies. The results of the investigation of two groups of materials, refractory compounds and binary alloy solid solutions are presented.

15738 (N—89-12876, pp 85-90) **Development of a high temperature static strain sensor.** Hulse, C.O.; Bailey, R.S.; Grant, H.P. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The goal of this program is to develop an electrical resistance strain gage system which will accurately measure the static strains of superalloy blades and vanes in gas turbine engines running on a test stand. Accurate knowledge of these strains is essential to reaching the goals of the HOST program in the selection and experimental verification of the various theoretical models developed to understand and improve the performance of these engines. The specific objective is to develop a complete system capable of making strain measurements of up to + or - 10 percent of full scale during a 50 hour period at temperatures as high as 1250 K. In addition to survival and stability, attaining a low temperature coefficient of resistance, of the order of 20 ppm/K or less, was a major goal. This requirement arises from the presently unavoidable uncertainties in measurement of the exact temperatures inside gas turbines for use in making corrections for apparent strain due to temperature.

15739 (N—89-12876, pp 91-96) **NASA Lewis Strain Gauge Laboratory: An update.** Hobart, H.F. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Efforts continue in the development and evaluation of electrical resistance strain gauges of the thin film and small diameter wire type. Results obtained early in 1986 on some Chinese gauges and Kanthal A-1 gauges mounted on a Hastelloy-X substrate are presented. More recent efforts include: (1) the determination of the uncertainty in the ability to establish gauge factor, (2) the evaluation of sputtered gauges that were fabricated at Lewis, (3) an investigation of the efficacy of dual element temperature compensated gauges when using strain gauge alloys having large thermal coefficients of resistance, and (4) an evaluation of the practical methods of stabilizing gauges whose apparent strain is dependent on cooling rate (e.g., FeCrAl gauges).

15740 (N—89-12876, pp 97-103) **Summary of laser speckle photogrammetry for HOST.** Pollack, F.G. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

High temperature static strain measurement capability is important for the success of the HOST program. As part of the NASA Lewis effort to develop the technology for improved hot-section durability, the HOST instrumentation program has, as a major goal, the development of methods for measuring strain at high temperature. Development work includes both improvements in resistance strain-gauge technology and, as an alternative approach, the development of optical techniques for high temperature strain measurement.

15741 (N—89-12876, pp 105-113) **Aerothermal modeling program, phase 2.** Karki, K.C.; Mongia, H.C.; Patankar, S.V.; Runchal, A.K. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The main objective of the NASA sponsored Aerothermal Modeling Program, Phase 2--Element A, is to develop an improved numerical scheme for predicting combustor flow fields. This effort consists of the following three technical tasks. Task 1 involves the selection and evaluation of various candidate numerical techniques. Task 2 involves an in-depth evaluation of the selected numerical schemes. Task 3 involves the convection-diffusion scheme and the direct solver that will be incorporated in the NASA 3-D elliptic code (COM3S).

15742 (N—89-12876, pp 115-124) **Aerothermal modeling program, phase 2. Element B: flow interaction experiment.** Nikjooy, M.; Mongia, H.C.; Murthy, S.N.B.; Sullivan, J.P. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The design process was improved and the efficiency, life, and maintenance costs of the turbine engine hot section was enhanced. Recently, there has been much emphasis on the need for improved numerical codes for the design of efficient combustors. For the development of improved computational codes, there is a need for an experimentally obtained data base to be used at test cases for the accuracy of the computations. The purpose of Element-B is to establish a benchmark quality velocity and scalar measurements of the flow interaction of circular jets with swirling flow typical of that in the dome region of annular combustor. In addition to the detailed experimental effort, extensive computations of the swirling flows are to be compared with the measurements for the purpose of assessing the accuracy of current and advanced turbulence and scalar transport models.

15743 (N—89-12876, pp 125-131) **Aerothermal modeling program, phase 2. Element C: fuel injector-air swirl characterization.** Mostafa, A.A.; Mongia, H.C.; McDonnell, V.G.; Samuelsen, G.S. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The main objectives of the NASA-sponsored Aerothermal Modeling Program, Phase 2--Element C, are experimental evaluation of the air swirler interaction with a fuel injector in a simulated combustor chamber, assessment of the current two-phase models, and verification of the improved spray evaporation/dispersion models. This experimental and numerical program consists of five major tasks. Brief descriptions of the five tasks are given.

15744 (N—89-12876, pp 141-143) **Efficient numerical techniques for complex fluid flows.** Patankar, S.V. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The central feature in any flow prediction method is the treatment of the coupling between the momentum and continuity equations. In natural-convection flows, the energy equation also becomes strongly coupled with the momentum equations. Because of the nonlinear nature of the coupling, these equations are solved iteratively. Iterative methods are often prone to slow convergence, divergence, and extreme sensitivity to underrelaxation factors. The aim of the present research is to develop more efficient and reliable solution schemes for the coupled flow equations. Such schemes will significantly reduce the expense of computing complex flows encountered in combustion chambers, gas turbines, heat exchangers, and other practical equipment. In the work completed so far, a technique employing norm reduction in conjunctine with the successive-substitution and Newton-Raphson techniques was developed. Also, a block-correction procedure for the flow equations is currently being formulated and tested.

15745 (N—89-12876, pp 145-150) **Improved numerical methods for turbulent viscous recirculating flows.** Vandoormaal, J.P.; Turan, A.; Raithby, G.D. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objective of the present study is to improve both the accuracy and computational efficiency of existing numerical techniques used to predict viscous recirculating flows in combustors. A review of the status of the study is presented along with some illustrative results. The effort to improve the numerical techniques consists of the following technical tasks: (1) selection of numerical techniques to be evaluated; (2) two dimensional evaluation of selected techniques; and (3) three dimensional evaluation of technique(s) recommended in Task 2.

15746 (N—89-12876, pp 151-157) **Influence of bulk turbulence and entrance boundary layer thickness on the curved duct flow field.** Crawford, R.A.; Peters, C.E. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objective of this investigation was the experimental evaluation of bulk turbulence and boundary thickness influence on the secondary flow development in a square, 90 deg turning duct. A three dimensional laser velocimetry system was utilized to measure the mean and fluctuating components of velocity in the large curved duct facility. The three dimensional development of the viscous shear layers in the curved duct has a strong influence on the complete flow field. Since ducted three dimensional flows are found in many engineering applications, including gas turbine engines, and contain high turbulence levels and high wall heat transfer rates, they present a difficult challenge to computational fluid mechanics codes. Turbulence modeling remains one of constraints to CFD advance due to inadequate physical understanding and experimental definition of turbulent shear flows. The results of this investigation expand the curved duct data base to higher turbulence levels and thicker entrance boundary layers. The experimental results provide a challenging benchmark data base for computational fluid dynamics code development and validation. The variation of inlet bulk turbulence intensity provides additional information to aid in turbulence model evaluation.

15747 (N—89-12876, pp 159-176) **Measurement of airfoil heat transfer coefficients on a turbine stage.** Dring, R.P.; Blair, M.F.; Joslyn, H.D. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The primary basis for heat transfer analysis of turbine airfoils is experimental data obtained in linear cascades. These data were very valuable in identifying the major heat transfer and fluid flow features of a turbine airfoil. The first program objective is to obtain a detailed set of heat transfer coefficients along the midspan of a stator and a rotor in a rotating turbine stage. The data are to be compared to some standard analysis of blade boundary layer heat transfer which is in use today. A second program objective is to obtain a detailed set of heat transfer coefficients along the midspan of a stator located in the wake of an upstream turbine stage.

15748 (N—89-12876, pp 177-192) **Heat transfer in the tip region of a rotor blade simulator.** Chyu, M.K.; Moon, H.K.; Metzger, D.E. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

In gas turbines, the blades of axial turbine stages rotate in close proximity to a stationary peripheral wall. Differential expansion of the turbine wheel, blades, and the shroud causes variations in the size of the clearance gap between blade tip and stationary shroud. The necessity to tolerate this differential thermal expansion dictates that the clearance gap cannot be eliminated altogether, despite accurate engine machining. Pressure differences between the pressure and suction sides of a blade drives a flow through the clearance gap. This flow, the tip leakage flow, is detrimental to engine performance. The primary detrimental effect of tip leakage flow is the reduction of turbine stage efficiency, and a second is the convective heat transfer associated with the flow. The surface area at the blade tip in contact with the hot working gas represents an additional thermal loading on the blade which, together with heat transfer to the suction and pressure side surface area, must be removed by the blade internal cooling flows. Experimental results concerned with the local heat transfer characteristics on all surfaces of shrouded, rectangular cavities are reported. A brief discussion of the mass transfer system used is given.

15749 (N—89-12876, pp 193-206) **Coolant passage heat transfer with rotation.** Hajek, T.J.; Wagner, J.; Johnson, B.V. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

In current and advanced gas turbine engines, increased speeds, pressures and temperatures are used to reduce specific fuel

consumption and increase thrust/weight ratios. Hence, the turbine airfoils are subjected to increased heat loads escalating the cooling requirements to satisfy life goals. The efficient use of cooling air requires that the details of local geometry and flow conditions be adequately modeled to predict local heat loads and the corresponding heat transfer coefficients. The objective of this program is to develop a heat transfer and pressure drop data base, computational fluid dynamic techniques and correlations for multi-pass rotating coolant passages with and without flow turbulators. The experimental effort is focused on the simulation of configurations and conditions expected in the blades of advanced aircraft high pressure turbines. With the use of this data base, the effects of Coriolis and buoyancy forces on the coolant side flow can be included in the design of turbine blades.

15750 (N—89-12876, pp 207-217) **Heat transfer with very high free-stream turbulence and streamwise vortices.** Moffat, R.J.; Maciejewski, P.; Eaton, J.K.; Pauley, W. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Results are presented for two experimental programs related to augmentation of heat transfer by complex flow characteristics. In one program, high free stream turbulence (up to 63 percent) was shown to increase the Stanton number by more than a factor of 5, compared with the normally expected value based on x-Reynolds number. These experiments are being conducted in a free-jet facility, near the margins of the jet. To a limited extent, the mean velocity, turbulence intensity, and integral length scale can be separately varied. The results show that scale is a very important factor in determining the augmentation. Detailed studies of the turbulence structure are being carried out using an orthogonal triple hot-wire anemometer equipped with a fourth wire for measuring temperature. The v' component of turbulence appears to be distributed differently from u' or w'. In the second program, the velocity distributions and boundary layer thicknesses associated with a pair of counter-rotating, streamwise vortices were measured. There is a region of considerably thinned boundary layer between the two vortices when they are of approximately the same strength. If one vortex is much stronger than the other, the weaker vortex may be lifted off the surface and absorbed into the stronger.

15751 (N—89-12876, pp 233-235) **Turbine stator flow field simulations.** Buggeln, R.C.; Briley, W.R.; Shamroth, S.J.; McDonald, H. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The increased capability and accessibility of modern computers, coupled with increasingly sophisticated and accurate numerical and physical modeling, has led to a marked impact of numerical simulations upon current turbine design and research problems. The turbine section represents a considerable challenge as it contains significant regions of complex three-dimensional flow, including both aerodynamic and heat transfer phenomena. The focus of the present effort is the development of an efficient and accurate three-dimensional Navier-Stokes calculation procedure for application to the turbine stator and rotor problems. In particular, an effective procedure is sought which: (1) adequately represents the flow physics, (2) allows for sufficient resolution in regions of small length scale, and (3) has sufficiently good convergence properties so as to allow use on a regular basis.

15752 (N—89-12876, pp 237-241) **Turbine airfoil film cooling.** Hylton, L.D. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Emphasis is placed on developing more accurate analytical models for predicting turbine airfoil external heat transfer rates. Performance goals of new engines require highly refined, accurate design tools to meet durability requirements. In order to obtain improvements in analytical capabilities, programs are required which focus on enhancing analytical techniques through verification of new models by comparison with relevant experimental data. The objectives of the current program are to develop an analytical approach, based on boundary layer theory, for predicting the effects of airfoil film cooling on downstream heat transfer rates and to verify the resulting analytical method by comparison of predictions with hot cascade data obtained under this program.

15753 (N—89-12876, pp 243-253) **Constitutive modeling for isotropic materials.** Lindholm, U.S.; Chan, K.S. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objective of the program is to evaluate and develop existing constitutive models for use in finite-element structural analysis of turbine engine hot section components. The class of constitutive equation studied is considered unified in that all inelastic deformation including plasticity, creep, and stress relaxation are treated in a single term rather than a classical separation of plasticity (time independent) and creep (time dependent) behavior. The unified theories employed also do not utilize the classical yield surface or plastic potential concept. The models are constructed from an appropriate flow law, a scalar kinetic relation between strain rate, temperature and stress, and evolutionary equations for internal variables describing strain or work hardening, both isotropic and directional (kinematic). This and other studies have shown that the unified approach is particularly suited for determining the cyclic behavior of superalloy type blade and vane materials and is entirely compatible with three-dimensional inelastic finite-element formulations. The behavior was examined of a second nickel-base alloy, MAR-M247, and compared it with the Bodner-Partom model, further examined procedures for determining the material-specific constants in the models, and exercised the MARC code for a turbine blade under simulated flight spectrum loading. Results are summarized.

15754 (N—89-12876, pp 255-256) **3-D inelastic analysis methods for hot section components.** Todd, E.S. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objective of this program is to produce a series of new computer codes that permit more accurate and efficient three-dimensional inelastic structural analysis of combustor liners, turbine blades, and turbine vanes. Each code embodies a progression of mathematical models for increasingly comprehensive representation of the geometrical features, loading conditions, and forms of nonlinear material response that distinguish these three groups of hot section components.

15755 (N—89-12876, pp 257-268) **3D inelastic analysis methods for hot section components.** McKnight, R.L.; Chen, P.C.; Dame, L.T.; Holt, R.V.; Huang, H.; Hartle, M.; Gellin, S.; Allen, D.H.; Haisler, W.E. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

Accomplishments are described for the 2-year program, to develop advanced 3-D inelastic structural stress analysis methods and solution strategies for more accurate and cost effective analysis of combustors, turbine blades and vanes. The approach was to develop a matrix of formulation elements and constitutive models. Three constitutive models were developed in conjunction with optimized iterating techniques, accelerators, and convergence criteria within a framework of dynamic time incrementing. Three formulations models were developed; an eight-noded mid-surface shell element, a nine-noded mid-surface shell element and a twenty-noded isoparametric solid element. A separate computer program was developed for each combination of constitutive model-formulation model. Each program provides a functional stand alone capability for performing cyclic nonlinear structural analysis. In addition, the analysis capabilities incorporated into each program can be abstracted in subroutine form for incorporation into other codes or to form new combinations.

15756 (N—89-12876, pp 341-357) **High temperature stress-strain analysis.** Thompson, R.L.; Moorhead, P.E. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

The objectives of the high-temperature structures program are threefold: to assist in the development of analytical tools needed to improve design analyses and procedures for the efficient and accurate prediction of the nonlinear structural response of hot-section components; to aid in the calibration, validation, and evaluation of the analytical tools by comparing predictions with experimental data; and to evaluate existing as well as advanced temperature and strain measurement instrumentation. As the analytical tools, test methods, tests, instrumentations, as well as data acquisition, management, and analysis methods are developed and evaluated, a proven, integrated analysis and experiment method will result in a more accurate prediction of the cyclic life of hot section components.

15757 (N—89-12876, pp 359-370) **Creep fatigue life prediction for engine hot section materials (isotropic): Fourth year progress review.** Nelson, R.S.; Schoendorf, J.F. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

As gas turbine technology continues to advance, the need for advanced life prediction methods for hot section components is becoming more and more evident. The complex local strain and temperature histories at critical locations must be accurately interpreted to account for the effects of various damage mechanisms (such as fatigue, creep, and oxidation) and their possible interactions. As part of the overall NASA HOST effort, this program is designed to investigate these fundamental damage processes, identify modeling strategies, and develop practical models which can be used to guide the early design and development of new engines and to increase the durability of existing engines.

15758 (N—89-12876, pp 371-383) **Elevated temperature crack growth.** Malik, S.N.; Vanstone, R.H.; Kim, K.S.; Laflen, J.H. Oct 1986. NTIS, PC A21/MF A01. (NASA-CP—2444; E—3205; NAS—1.55:2444; CONF-8610163—).

From 5. annual workshop on turbine engine hot section technology; Cleveland, OH, USA (21 Oct 1986).

It is necessary to relate the processes that control crack growth in the immediate vicinity of the crack tip to parameters that can be calculated from remote quantities, such as forces, stresses, or displacements. The most likely parameters appear to be certain path-independent (PI) integrals, several of which have already been proposed for application to high temperature inelastic problems. The ability of currently available PI-integrals to correlate fatigue crack propagation under conditions that simulate the engine combustor liner environment was determined. The utility of advanced fracture mechanics measurements will also be evaluated and determined during the course of the program.

15759 **(NP—9770224) Studies on the evaporation of EL heating oil and diesel fuel during mixture pre-treatment for pre-evaporation combustion units with low output.** Bothien, M.R. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 22 Apr 1987. 109p. (In German). NTIS (US Sales Only), PC A06. Order Number DE89770224/JAW.

A method was developed with a view to rationalising the operation of heating boilers. In it, the fuel is evaporated and evenly mixed with the combustion air. An evaporator of this kind working on the principle of recirculating liquid fuel. Alongside the practical experiment, a mathematical model of the evaporator was used. A computer programme was used to calculate the optimum figures for the major dimensioning parameters, especially the optimum status of the fuel/air mixture fed into the burner. On the basis of the computer simulation of stationary operating behaviour at different outputs, indications of operational limits were to be derived. This report covers the evaporator model, the undefined multi-substance mixture (boiling analysis, phase equilibrium) and the experimental setups (evaporation of a model liquid). The calculated and experimental results are compared. Details are given on the oxidation and ageing of an oil. (HWJ).

15760 **(VTT-TUTK—546) Heat transfer in fireduct-firetube boiler.** Uuttu, T.; Orjala, M.; Heiskanen, V.-P. (Valtion Teknillinen Tutkimuskeskus, Jyvaeskylae (Finland). Kotimaisten Polttoaineiden Lab.). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1988. 55p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756315/JAW.

The research reports heat exchange measurements of fireduct-firetube boilers, which were carried out with the 300 kW test boiler in the Technical Research Centre of Finland, Domestic Fuel Laboratory and in four other boilers in normal use. In the measurements carried out in the plants it was observed that the efficiency varied from 88 to 93 percent, depending on the boiler and output used. In all boilers the formation of the efficiency was determined almost completely by a loss caused by the sensible enthalpy of the flue gas. Other losses were close to the minimum or at least so small that the efficiency of the boilers would not be significantly improved by reducing them. From the point of view of the minimization of the loss caused by the sensible enthalpy of the flue gas, a boiler type, in which the water temperature of the economizer could be adjusted and the flue gas temperature thus brought as low as desired over the entire area of output, was found to be good. By this adjustment it is, on the one hand, possible also to ensure that the temperature of the flue gas even on partial output does not drop below the dewpoint of sulphuric acid. The solids contents were measured from the furnace of one boiler. The heat exchange of the furnace was investigated in more detail in the test boiler. The intensity of the radiation at various points in the walls of the furnace was measured with an ellipsoidal total radiation heat flow meter. The distribution of the total heat exchange was measured by determining the output transferred to each of the six parts of the furnace. The emissivities of the flame were measured with a total radiation pyrometer, with which values in order of 0.5-0.8 were achieved. The measurements achieved were used for setting and testing the parameters of a programmed heat exchange model in connection with the project. It was shown that the programme had achieved quite a good accuracy.

15761 **Hydrodynamics of erosion of heat exchanger tubes in fluidized bed combustors.** Bouillard, J.X.; Lyczkowski, R.W.; Folga, S.; Gidaspow, D.; Berry, G.F. New York, NY; American Institute of Chemical Engineers (1987). 38p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 150CC.

The hydrodynamics of fluidization for two thin "two-dimensional" fluidized beds, one containing a centrally located rectangular obstacle and the other containing three square tubes roughly approximating a portion of a fluidized bed combustor (FBC), was solved using the FLUFIX/MOD2 computer program. The monolayer energy dissipation erosion model extended to include solids viscous stress was compared with the Finnie erosion model. Hydrodynamic and erosion convergence studies were performed for the first bed. Computed erosion rates from the energy dissipation erosion model compare more favorably for both beds with available erosion data than those from the Finnie erosion model.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 14146

15762 **(LA—11492-OBES) Field procedures manual: Sample handling, Salton Sea Scientific Drilling Project.** Goff, S.; Mehegan, J.; Michels, D. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006377/JAW.

This Field Procedures Manual is the comprehensive operations guide that was used to curate samples obtained from the

Salton Sea Scientific Drilling Project (SSSDP). It is being published in the form used on site by the curation team. Samples recovered from the SSSDP were curated following the Policy Guidelines established for the Department of Energy/Office of Basic Energy Sciences (DOE/OBES) Continental Scientific Drilling Program (CSDP)/Thermal Regimes effort, which recognizes the uniqueness and site-specific nature of each drilling project. The SSSDP is a rotary drilling project that has provided cuttings and spot cores as well as liquid and gas samples. This manual provides details on handling all of these sample types. 6 refs., 10 figs.

15763 (NP—9770217) WBK annual report 1987. (Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.)). [1988]. 97p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770217/JAW.

The annual report presents the services and R and D activities in 1987 in the fields of conveyance, materials science, explosion protection, shotfiring technology, mine ventilation machinery, ergonomics, geophysics, vibration and noise abatement technology, applied geology, chemistry, and environmental protection. Primary and secondary training courses are listed, and the work and new exhibits of the German Mining Museum are presented. (MOS).

15764 (SAND—88-1642) Shock- and release-wave properties of MJ-2 grout. Grady, D.E.; Furnish, M.D. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 115p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007057/JAW.

High pressure Hugoniot and release equation of state data are provided for a high-silica high-water content rock-simulating grout (Mini Jade Two grout) over a pressure range of approximately 1 to 70 GPa. High velocity gun impact shock wave techniques and velocity interferometry diagnostics were used to obtain the experimental data. New experimental methods and analysis techniques were developed to perform the tests and extract the Hugoniot and pressure-volume release properties of the grout. The data are appropriate for high pressure equation of state development through both computational simulation and direct comparison with Hugoniot and release isentrope behavior. Nonlinear deformation phenomena associated with material strength, pressure-induced phase transformation and pressure-volume hysteresis are identified within the experimental results and the underlying responsible physical issues are addressed. 29 refs., 68 figs., 5 tabs.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 14315, 15468

15765 (BA—AES/SAG1-2:86-17v2) Ice structure interaction: engineering design and construction criteria. Vol. 2, user's manual. Bercha, F.G. (Bercha (F.G.) and Associates Ltd., Ottawa, Ontario (Canada)). 1986. 59p. (CE—02300). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The General Ice-Structure Interaction Load Evaluation Model (GISILEM) utilizes static and dynamic theories of ice behavior to generate ice loads for scenarios involving the interaction of ice with offshore structures. These scenarios involve sheet ice crushing and flexure, first-year and multi-year ridge failure, ride-up and pile-up interactions, and dynamic interaction of discrete ice objects such as multi-year ice floes. The Ice-Structure Interaction Load Pressure Evaluation Model (ISILPEM) is used to calculate local loads using finite element methods; it produces as output a stress map of small-scale structural interaction for a variety of local structural configurations and models of ice rheology. This manual provides the user of GISILEM and ISILPEM with a guide to the input requirements and output capabilities of those computer models, and includes descriptions of fields and files, as well as sample input and output data. 7 figs., 4 tabs.

15766 (DNV—AES/SAG1-2:86-9) State-of-the-art methods for computing global and local loads in ice-structure interaction. (Det Norske Veritas (Canada) Ltd.). 1986. 196p. (CE—02292). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The estimation of interactions between ice and offshore structures is approached on the basis of the understanding of ice as a material and an appreciation of the environmental conditions under which the interaction takes place. The basic principles of ice mechanics, ice morphology and ice interactions are presented as background to the later discussion of failure phenomena associated with different types of structures. The manner in which structures fail depends on the geometry of the structure, and separate descriptions of failure modes are given for both vertical and sloping structures as well as for artificial islands. Methods for calculating the resulting forces on the structures are surveyed. Loads resulting from thermal expansion of confined ice covers are addressed as are the self-induced vibrations resulting from the continuous crushing of ice against a slender structure. The report also discusses the calculation of local pressures which are influenced by mechanical and stochastic phenomena. The behavior of ice in the field is strongly dependent on random phenomena such as the presence, size, and type of zones of weakness, and the uncertain loading of winds and waves. The uncertainties associated with the estimation of ice forces and suggested probabilistic models are then reviewed, and recommendations are made for the direction of future research. 212 refs., 84 figs., 8 tabs.

15767 (SWE—AES/SAG1-2:86-10) Towing and setting caissons in the Canadian Beaufort Sea. Skalmstad, B. (Swan Wooster Engineering Co. Ltd., Vancouver, British Columbia (Canada)). 1986. 107p. (CE—02293). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Caissons have significant advantages in construction of offshore structures in the Arctic, as they can be prefabricated off-site and can be reused at several sites. There are a number of problems with using caissons in the Arctic, however, and this report reviews some of them. It covers the different stages of caisson installation such as transportation of the structures to the Arctic (towing equipment and techniques, choice of east or west route), preparation of the foundation, placing and refloating caissons, and site location control and sounding surveys. Approximate transporation and installation costs are compiled, and appropriate trip durations are given. For each stage, a general description is provided as well as information specific to each of the caissons which has been or will be installed in the Arctic. 23 refs., 19 figs., 5 tabs.

15768 (CRA—AES/SAG1-2:86-7) Evaluation of ice pressure sensors and strain meters in a large ice test basin. (Croasdale (K.R.) and Associates, Calgary, Alberta (Canada)). 1986. 149p. (CE—02294). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A project was conducted to evaluate how well various types of ice pressure sensors and strainmeters measured in-situ ice stresses, and how accurately they predicted known ice loads on a structure. The project was done in a large open-air test basin, with 22 tests performed by applying loads up to 155 tons through the sheet and measuring the loads against a reaction structure. Both short term (elastic) and long term (creep) tests were carried out, and 10 different types of sensors were included. A comparison between actual nominal ice pressure on the structure (based on the reaction loads) and that predicted from the sensor readings (combined with a finite-element analysis of stress distribution) was presented for each sensor for all tests. In general the experiment was successful, and the results indicate that for most sensors, the overall ability to predict loads on a structure from in-situ ice stress (or strain) readings is quite good. For example, for those in-situ ice pressure sensors that were operational, the average difference between the actual ice loads and loads based on the sensor readings and the finite-element analysis was better than about 30%. Certain

practical considerations were found to be necessary when using certain sensor types; for example, some ice bending occurred which tended to adversely affect the ability of surface strain meters to measure overall compressive stress. Also, in some cases, using saline water to freeze the sensor into the ice sheet adversely affected sensor performance when ambient temperatures were around 0 / sup 0/ C. 18 refs., 82 figs., 12 tabs.

15769 **(FMLSE—AES/SAG1-2:86-12) Evaluation of the MEDOF ice load sensor in the Arctic environment.** Strandberg, A. (Fenco MacLaren Shawinigan Engineers, Inc., Calgary, Alberta (Canada)). 1986. Vp. (CE—02295). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The MEDOF brand ice stress panel is a hydraulic load vs fluid output device that has been extensively used in offshore operations in the Arctic. This report evaluates the performance of two MEDOF panels installed in Arctic ice at a remote location on Baffin Island and monitored for 3 months. One of the panels measured stress with excellent accuracy, but it was found that the outputs were sensitive to temperature when stress levels in the order of 100 kilopascals were being measured. It was therefore necessary to compensate the system for temperature variations. The stress measured by one panel was caused by the tide and it clearly increased during the course of the season. 25 figs.

15770 **(AC—AES/SAG1-2:86-13) Evaluation of ice force sensors in the Arctic environment.** Newar, A.M.; Edworthy, J.; Steele, M.; Blant, H. (Arctec Canada Ltd., Kanata, Ontario). 1986. 150p. (CE—02296). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A program was conducted to make a comparative evaluation of a number of ice load/pressure sensors at a test site in Baffin Island. An ice pressure monitoring system was evaluated, and this system consisted of: a load profile transducer in the form of a 1-m square with six sensor strips gauged and wired separately; a thermistor string to monitor the temperature gradient in the ice cover, in order to be able to isolate pressure gradients caused by thermal effects; and a data acquistion and recording system. This report describes the installation, monitoring, calibration, and performance of that system. It was found that the temperature gradient over the test period was practically linear with small curvature. The ice sheet pressure distribution was seen to be a complex function of the tidal cycles, with low tide corresponding to times of maximum pressure near the bottom of the ice sheet. Maximums at the top of the sheet occurred a few hours after high tide. Based on the measurements, the actual pressure in the ice sheet due to combined tidal and thermal cycles was in excess of 16 psi. However, extrapolated data indicate higher estimates of the average and peak pressures in the ice sheet. It appears that the ice pressure varies across the ice thickness and appears to have a consistent peak below the top surface of the ice sheet. 4 refs., 105 figs., 4 tabs.

15771 **(DNV—AES/SAG1-2:86-19) Development of analytical models related to experimental work on ice structure interaction.** Tomin, M.J.; Cormeau, A.; Jordan, I.J. (Det Norske Veritas (Canada) Ltd.). 1986. 252p. (CE—02298). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report examines the mechanics of the interaction process that leads to the failure of ice. The analysis and numerical modelling concentrate on four distinct phenomena: creep; initiation of internal cracking; local progressive fracture (damage); and global fracture. The finite element method was used since it is free from geometric and boundary condition limitations imposed by closed form solutions. This method permitted, along with fracture, the inclusion of constitutive relationships of material that vary in both time and space; these are essential for ice modelling at high indentation rates. An advanced, nonlinear finite element analysis program called ABAQUS, which was the main tool for modelling ice response, gave useful numerical results. The models that were studied by finite element analysis were an elastic model, a nonlinear viscoelastic model (primary and secondary creep) and a fracture model. The elastic model was used to study the effect of boundary conditions on the global response of ice; it was found that the boundary close to the indenter, created by penetration of the indenter, has a considerable effect on the stress distribution under the indenter. The viscoelastic model was used to find the steady state and to identify the sinks of energy dissipation. The J-integral fracture criterion was successfully applied to assess propagation of both large cracks, as well as the grain-size cracks under the indenter. 85 refs., 130 figs.

15772 **(BA—AES/SAG1-2:86-17v1) Ice structure interaction: engineering design and construction criteria. Vol. 1.** Bercha, F.G. (Bercha (F.G.) and Associates Ltd., Ottawa, Ontario (Canada)). 1986. 189p. (CE—02299). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report describes the development of analytical models used for evaluation of the effects of interactions between marine ice and fixed offshore Arctic structures. Regional ice zones are defined for the Canadian Arctic, and the morphological, kinematic, and mechanical properties of ice are outlined. Discussion is presented of structural concepts applicable to different types of offshore structures (artificial islands, monopods, multipod structures), their relative engineering advantage, and the selection of structural parameters to be used in the analysis. Ice-structure interaction theory is developed, along with mathematical expressions of global quasi-static behavior, global dynamic behavior, and local behavior. Load calculation methodology is introduced, and the development of computer models, used to calculate global loads, local pressures, and load results, is described. Sample results of interaction load calculations are given, using the two models developed: the General Ice-Structure Interaction Load Evaluation Model (GISILEM) and the Ice-Structure Interaction Local Pressure Evaluation Model (ISILPEM). 53 refs., 55 figs., 8 tabs.

15773 **(MU/CCORE—AES/SAG1-2:86-11) The analysis of strain meter data at Nanisivik Wharf.** Stander, E.; Harmon, J. (Memorial Univ. of Newfoundland, St. John's (Canada). Centre for Cold Ocean Resources Engineering). 1986. 29p. (CE—02303). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents data on the finite and incremental strains present in the ice off Nanisivik Wharf on Baffin Island. The work was part of a project to evaluate ice load sensors in the Arctic environment. Three strainmeters were emplaced off the wharf and connected to monitoring equipment, and monitored from January to March 1984. The results of the strainmeter analysis are presented in graphical format; five graphs are presented for each of two time periods. The data has been synthesized into the following parameters: finite strainmeter values; incremental strain (maximum and minimum) and angular rotation of the rosette; finite strain (maximum and minimum) and angular rotation of the rosette; incremental dilational and deviatoric strain and the maximum and minimum strain rates; and finite dilatation and deviatoric strain and the maximum and minimum strain rates. 11 figs.

15774 **(BA—AES/SAG1-2:86-18v1) Probabilistic ice load analyses of Caps Noir wharf. Vol. 1, detailed analysis.** Bercha, F.G. (Bercha (F.G.) and Associates Ltd., Ottawa, Ontario (Canada)). 1986. 35p. (CE—02302). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In 1973, the wharf at Caps Noirs on the Gaspe Peninsula (Quebec) was seriously damaged by encroaching ice pack. An evaluation was then undertaken of the probability of such an occurrence of a magnitude sufficient to cause damage to the wharf. In order to evaluate the probable ice loads experienced by the structure, detailed information was obtained on the kinematics of ice features at the wharf location. Wind statistics were also compiled in order to define the event fully. The extent of the damage to the

wharf indicated that, although dynamic effects may have contributed to the failures, the ice behavior could be evaluated on the basis of a static interaction. Equations defining the interaction load were developed, and the modes of failure of the wharf piles were analyzed. The principal failure mode considered was plastic flexural failure. Probabilistic load calculations were performed to determine the combined probability of occurrence of sufficient wind shear and sufficient ice thickness. It was concluded that the pile failure loads are dependent on the ice location, and therefore the tide level, at any time. Given this dependence, however, the return periods for the ice loads vary from 19.2 to 126 years. Assuming a factor of safety against failure of the piles of 1.8, the design life for an ice load applied at mean water level is 11 years if the base is assumed fixed and 7.9 years if the base is assumed hinged. True pile behavior would lie somewhere between these limits. 4 refs., 11 figs., 5 tabs.

15775 **(BA—AES/SAG1-2:86-18v2) Probabilistic ice load analysis of Caps Noirs wharf. Vol. 2, general approach.** Bercha, F.G. (Bercha (F.G.) and Associates Ltd., Ottawa, Ontario (Canada)). 1986. 24p. (CE—02301). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents a general procedure to determine probable ice loads on offshore structures and the associated risk of failure. The calculations are based on data obtained from a probabilistic evaluation of the failure of a wharf located on the Gaspe Peninsula, Quebec, due to flexure failure of the vertical-edge piles caused by plastic bending under the stress of an ice load. The steps required in this procedure are: accumulation of required ice kinematic and mechanical statistics and environmental statistics; analysis of statistics and frequency distribution curve fitting; development and application of deterministic equation(s) for appropriate ice-structure interactions and their transformation to random variable form; combination of probabilities to give composite probability of interaction loads; evaluation of the resistance of the structure for the identified failure mode(s) and distribution curve; and evaluation of load and resistance curves to give the risk of failure. The degree of difficulty in the above procedure will depend on the amount of statistical data to be analyzed and the number of interactions. 55 refs., 4 figs.

4250 Power Cycles

REFER ALSO TO CITATION(S) 15079

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 15848, 16406

15776 **(CEA-CONF—9431) Damping of the hom's in a multicell superconducting cavity.** Mosnier, A.; Aune, B.; Bourbonneux, J.; Djidi, K.; Juillard, M.; Nicolai, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de l'Accelerateur Lineaire). 1988. 3p. (CONF-880695—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756643/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The damping of higher order modes (HOM) was studied for the design of a recirculating linac with superconducting cavities. Measurements on a large iris aperture 5 cell copper cavity equipped with two coaxial HOM couplers, designed for the 1.5 GHz accelerating mode are reported. A cavity design with a smaller number of cells and iris diameters, associated with simpler couplers, resulting in a better optimization for HOM damping and the fundamental mode parameters, is proposed.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 15648, 15807, 15823, 16796, 16807, 16829, 16831

15777 **(CTA-IEAV-NT—003/88) Study on the dependence of the resonance frequency of accelerators on the cavities internal diameter.** Serrao, V.A.; Franco, M.A.R.; Fuhrmann, C. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados). May 1988. 20p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705420/JAW.

The resonance frequencies of individual cavities and of a six cell disk-loaded prototype of an accelerating structure were measured as a function of cavity inner diameter. A linear relationship between the indidual cavity frequency and the six cell stack 2PI/3 mode frequency was obtained that will be very useful during the final tuning of the accelerating strutures of the IEAV linac. The dispersion diagrams were also obtained for various internal cavity diameters; these diagrams were utilized to estimate the group velocity and the RF filling time of the accelerating structure.

15778 **(FNAL/C—88/169) The Fermilab PBAR-P Collider: Present status and future plans.** Johnson, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1988. Contract AC02-76CH03000. 6p. (CONF-8810289—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005623/JAW.

From 11. All-Union conference on charged particle accelerators; Dubna, USSR (25 Oct 1988).

The Tevatron Collider is performing beyond expectations for its first physics run. The peak luminosity is already 1.6 times the design goal of 10^{30} cm/sup {minus}2/ s/sup {minus}1/. The anticipated integrated luminosity recorded by the major detector, CDF, is 3 inverse picobarns which should be sufficient to see the top quark if its mass is less than 110 GeV. The next two Collider runs will have improved performance with luminosity approaching 10^{31} at two interaction regions. In the years between 1993 and 2000, the Collider energy will be increased by using the highest field superconducting magnets then available, where 8.8 T would give 2 TeV on 2 TeV pbar-p collisions with a luminosity above 10^{31}. To facilitate this possibility and to improve the general Collider capabilities, a new 150 GeV Main Injector is now being designed. 3 figs., 2 tabs.

15779 (INIS-mf—11348, pp 60) **Operation and tests of monochromator model 305-SMP.** Tar Ortiz, J.A.; Munoz Castro, A.; Ondarza R, R. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15780 (INIS-mf—11351, pp 119-124) **Clinical experience from 10-50 MeV medical microtrons.** Walstam, R. (Stockholm Univ. (Sweden). Dept. of Radiation Physics). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The benefits and constraints of the use of high energy photons and electrons in radiotherapy are presented and the two main trends are described of the current development in microtron therapy: scanning beam technique and the twice focused multileaf collimator. The physical properties are described of microtron beams, maintenance and reliability of microtrons with linear accelerators and betatrons. (E.S.). 2 figs., 4 refs.

15781 (INIS-mf—11351, pp 125-126) **Cobalt irradiators yesterday, today and tomorrow.** Frencl, L.; Kubec, V.; Zamecnik, J. (Radioterapeuticky Ustav, Prague (Czechoslovakia)). Aug 1987. (In Czech). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

15782 (INIS-mf—11351, pp 127-132) **Method of accelerator control in arc therapy.** Ochec, J.; Bednar, F. (Zakladna Rozvoje Uranoveho Prumyslu, Ostrov nad Ohri (Czechoslovakia); Radioterapeuticke Oddeleni Nemocnice, Cheb (Czechoslovakia)). Aug 1987. (In Czech). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The principle was used of step arc therapy for continuous arc therapy. The errors are discussed which may affect the accuracy of the therapy. On the basis of this knowledge a control system was designed for controlling continuous arc therapy and an intelligent control dosemeter was designed for controlling step therapy using microcomputers. The first equipment is designed for the Czechoslovak betatron B 22 L with the maximal energy of 22 MeV. The dosemeter is designed for a medical 19 MeV betatron and will be tested a several betatron workplaces. The advantage of the step therapy is the reliable distribution of the dose in the irradiated object, ease of control and high reliability. The developed system of step therapy may be modified for use on any accelerator where constant dose rate or angular velocity must be provided. (E.S.). 4 figs., 3 refs.

15783 (INIS-SU—68, pp 579) **Method for acceleration of single ions with A=1-16 in the energy range of 20-500 keV.** Mitrokhin, O.E.; Strizhak, V.I.; Shevchenko, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15784 **(LA—11432-C) Proceedings of the Advanced Hadron Facility accelerator design workshop.** Thiessen, H.A. (comp.). (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 510p. (CONF-880263—). NTIS, PC A22/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006867/JAW.

From Advanced Hadron Facility accelerator design workshop; Los Alamos, NM, USA (22 Feb 1988).

The International Workshop on Hadron Facility Technology was held February 22-27, 1988, at the Study Center at Los Alamos National Laboratory. The program included papers on facility plans, beam dynamics, and accelerator hardware. The parallel sessions were particularly lively with discussions of all facets of kaon factory design. The workshop provided an opportunity for communication among the staff involved in hadron facility planning from all the study groups presently active. The recommendations of the workshop include: the need to use h=1 RF in the compressor ring; the need to minimize foil hits in painting schemes for all rings; the need to consider single Coulomb scattering in injection beam los calculations; the need to study the effect of field inhomogeneity in the magnets on slow extraction for the 2.2 Tesla main ring of AHF; and agreement in principle with the design proposed for a joint Los Alamos/TRIUMF prototype main ring RF cavity.

15785 **(SAND—87-1563) The structure and function of the PBFA-II control system.** Goldsmith, S.Y. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89007006/JAW.

This report identifies major hardware and software components comprising the Particle Beam Fusion Accelerator II (PBFA-II) control system. Both the system architecture and the theory of operation are discussed. It is intended to be a general introduction for engineers involved in the maintenance and extension of the control system. The companion to this document, "System Manager's Technical Guide for PBFA-II Control/Monitor System," SAND87-1564, contains the detailed documentation on the system software as well as procedures for configuration management. The material covered in this document is prerequisite to SAND87-1564. 3 refs., 17 figs.

15786 **Operational experiences of the Tevatron.** Theilacker, J.C. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL (US));. pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US));. New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

Fermilab is a National Laboratory which provides the tools necessary to support and perform high energy physics experiments. The tools are in the form of proton accelerators. In the early 1980's a superconducting accelerator, the Tevatron, was built as an upgrade to the original 500 GeV accelerator. The Tevatron was designed at twice the energy (1TeV), yet offered a reduction in operating costs over the 500 GeV conventional magnet accelerator. Magnet development was the principal concern of this project from 1972 to 1979. Then, from its near-final design in the late 1970's the Tevatron required considerable research and development in the areas of large scale superconducting magnet production, large scale helium refrigeration and transport, vacuum technology, quench protection and controls systems to date, it is the highest energy proton accelerator in the world. The Tevatron is a 2 km diameter synchrotron consisting of nearly 1300 cryogenic components as shown in Table 1. Its primary components are the dipoles, quadrupoles and a spool pieces. The 6.3m bending dipoles utilize a NbTi alloy superconductor to achieve 4.4 Tesla. Spool pieces house a variety of components. These include; correction magnets, quench stopper, vacuum barrier, relief valves, and thermometry. Every other spool piece contains safety leads which bypasses current around a quenched cell of magnets.

15787 **The continuous electron beam accelerator facility (CEBAF).** Campisi, I.E. (Superconducting Radio Frequency Div., CEBAF, 12000 Jefferson Avenue, Newport News, VA (US)). pp v of Superconductivity and its application. Kowk, H.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Buffalo, NY (US)). New York, NY; Elsevier Science Pub. Co. Inc. (1988). (CONF-880466—).

From 2. annual conference on superconductivity and its applications; Buffalo, NY, USA (18 Apr 1988).

During the past year active construction has been taking place at what by the year 1993 will be one of the major centers in the world for fundamental nuclear physics studies, the Continuous Electron Beam Accelerator Facility (CEBAF). Located in Newport News, Virginia and funded by the Department of Energy, CEBAF is operated by the Southeastern Universities Research Association (SURA), a consortium of 38 institutions. The objective of the laboratory is to study the subnuclear properties of nuclear matter, with particular emphasis on the characteristics of the many body interactions inside the nuclei, both from the point of view of the nucleon-meson structure and of the quark-gluon structure of the nucleons: these studies should lead to a better understanding of the relationship between strong and electro-weak interactions in nuclei and of the role of quarks in nuclear interactions. These goals will be accomplished through the use of an electron beam aimed at targets inside three experimental stations containing spectrometers and detectors. In order to assure that the nuclear physics program can be carried out to its fullest potential, the properties of the electron beam will be optimized for this purpose.

15788 **Characterization of a large-format, high-fidelity, picosecond, optical streak camera.** Lancaster, G.; Jander, D.; Grasz, E.; Simpson, B.; Lerche, R.; Rickard, B.; Imhoff, C. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

The authors completed preliminary characterizations of a new 3-grid, large-format, ITT streak camera tube operating with about a 2.3-kV extraction voltage. They found that the best attainable impulse response if —10 ps at low input intensity. However, the impulse response increases to only 30 ps with an increase of nearly three orders of magnitude in input intensity. Further, the

spatial resolution remains greater than 5 line pairs/mm at 50% contrast over these three orders of magnitude of input intensity. The authors have also done preliminary computational modeling of the tube's temporal response as a function of focus voltage, illumination spot size, and wavelength.

15789 **Streak tube characterization for transient recording.** Jennings, T.B.; Olsen, R.W. (EG and G Energy Measurements, Los Alamos Operations, P.O. Box 809, Los Alamos, NM (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

This paper describes the methods used by EG and G Energy Measurements to characterize a streak tube. Both radiometric (QE, uniformity, gain, linearity, extinction ratio, opacity) and resolution (static, spatial, and temporal) tests are covered. The significance of these measurements with respect to streak camera applications is discussed. The results of the measurements on a streak tube designed and built by EG&G Amador Valley Operations are included as an illustration.

15790 **Streak camera system spatial resolution limitation by MCP image intensifiers.** Stradling, G.L. (Los Alamos National Lab., PO Box 1663, Los Alamos, NM (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

The contribution to the degradation of image resolution fidelity in stream camera systems by proximity-focus MCP image intensifiers is explored. These image intensifiers are found to have a significant limitation on overall system performance.

15791 **Accelerators for heavy ion fusion.** Bangerter, R. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

Large fusion devices will almost certainly produce net energy. However, a successful commercial fusion energy system must also satisfy important engineering and economic constraints. Inertial confinement fusion power plants driven by multi-stage, heavy-ion accelerator appear capable of meeting these constraints. The reasons behind this promising outlook for heavy-ion fusion are given in this report. This report is based on the transcript of a talk presented at the Symposium on Lasers and Particle Beams for Fusion and Strategic Defense at the University of Rochester on April 17-19, 1985.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 14770, 15671

15792 **(ANL-HEP-CP—88-62) Final focus plasma lenses in linear colliders.** Rosenzweig, J.B.; Chen, Pisin. (Argonne National Lab., IL (USA)). 11 Oct 1988. Contract W-31109-ENG-38. 35p. (CONF-8804238—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005785/JAW.

From CAPRI workshop on future linear colliders; Capri, Italy (13 Apr 1988).

In this paper we analyze the optics of a high energy beam which is focused by its own wake-fields in an overdense plasma. We calculate the effects of lens aberration on the focusing strength of the lens and on the dilution of the beam's phase space density. From this we derive the minimum spot size achievable using a cylindrically symmetric bi-Gaussian beam and, after inclusion of the beam-beam disruption effect, the luminosity enhancement that can be gained in principle. We estimate the luminosity enhancement in the case of SLC design parameters and discuss limitations and possible improvements in plasma lens performance. Motivated by the need to reduce the background event rate due to beam-ion collisions, we discuss the optics of the underdense plasma lens and introduce the concept of bootstrap disruption. Possible use of the underdense plasma lens in a TLC-type collider is examined. 14 refs., 5 figs., 1 tab.

15793 **(FNAL-TM—1550) Beam-beam tuneshift during the TEVATRON squeeze.** Mane, S.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1988. Contract AC02-76CH03000. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005998/JAW.

We calculate the beam-beam tuneshift during the squeeze of the beam in the Tevatron from injection to mini-beta. We find that for the beam emittances typically used, there is little variation of the tuneshift, in either plane, during the squeeze. 7 figs., 2 tabs.

15794 **(FNAL-TM—1552) Wide Band to "Double Band" upgrade.** Kasper, P.; Currier, R.; Garbincius, P.; Butler, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1988. Contract AC02-76CH03000. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006570/JAW.

The Wide Band beam currently uses electrons obtained from secondary photon conversions to produce the photon beam incident on the experimental targets. By transporting the positrons produced in these conversions as well as the electrons it is possible to almost double the number of photons delivered to the experiments per primary beam proton. 11 figs.

15795 **(FNAL-TM—1554) Linear beam-beam tune shift calculations for the Tevatron Collider.** Johnson, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 12 Jan 1989. Contract AC02-76CH03000. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006569/JAW.

A realistic estimate of the linear beam-beam tune shift is necessary for the selection of an optimum working point in the tune diagram. Estimates of the beam-beam tune shift using the "Round Beam Approximation" (RBA) have over estimated the tune shift for the Tevatron. For a hadron machine with unequal lattice functions and beam sizes, an explicit calculation using the beam size at the crossings is required. Calculations for various Tevatron lattices used in Collider operation are presented. Comparisons between the RBA and the explicit calculation, for elliptical beams, are presented. This paper discusses the calculation of the linear tune shift using the program SYNCH. Selection of a working point is discussed. The magnitude of the tune shift is influenced by the choice of crossing points in the lattice as determined by the pbar "cogging effects". Also discussed is current cogging procedures and presents results of calculations for tune shifts at various crossing points in the lattice. Finally, a comparison of early pbar tune measurements with the present linear tune shift calculations is presented. 17 refs., 13 figs., 3 tabs.

15796 **(GSI—88-55(prepr.)) Ions penetrating through ion-optical systems and matter - non-Liouvillian phase-space modelling.** Geissel, H.; Armbruster, P.; Schmidt, K.H.; Muenzenberg, G.; Schwab, T.; Dufour, J.P.; Hanelt, E.; Sherrill, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Giessen Univ. (Germany, F.R.); CEA Centre d'Etudes Nucleaires de Bordeaux-Gradignan, 33 - Gradignan (France); Technische Hochschule Darmstadt (Germany, F.R.); Michigan State Univ., East Lansing (USA)). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Giessen Univ. (Germany, F.R.); Technische Hochschule Darmstadt (Germany, F.R.); Michigan State Univ., East Lansing (USA)). Oct 1988. 33p. (CONF-8809289—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From INTDS and IAEA-INDC conference on heavy-ion targets and related phenomena; Darmstadt, F.R. Germany (5 Sep 1988).

Desirable and inevitable phase-space modifications for heavy ions propagating through matter and ion-optical systems are described. Some aspects of the interaction of energetic ions with matter incorporated in ion-optical devices and the use of profiled targets at relativistic energies are discussed. A variety of measured and calculated results is presented which demonstrates interesting applications, including the interaction of heavy ions under channeling conditions or with free electron targets, the separation and implantation of radioactive beams. As examples, some of the new GSI projects are briefly presented which illustrate the growing importance of non-Liouvillian ion-optics.

15797 (INIS-SU—69, pp 36-38) **Observation of coherent ondulator radiation in a hybrid ondulator.** Alekseev, V.I.; Alieva, E.V.; Belovintsev, K.A.; Bessonov, E.G.; Mityagin, Yu.A.; Murzin, V.N.; Serov, A.V. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.
In Experimental and theoretical physics. Collection.

The spontaneous coherent ondulator radiation in the millimeter wave length range emitted by electron bunches with the 7 MeV energy in the hybrid ondulator is registered. Ondulator magnetic field period is 168 or 126 mm. So, the ondulator had 6 or 8 periods at the magnetic field amplitude in the gap of 2600 or 1700 Oe. The distance between magnet poles is 28 mm. The ondulator gap accomodates the cylindrical waveguide made of stainless steel with 26 mm diameter 1000 mm long. The dependence of radiation intensity on bunch length is studied experimentally. Radiation power constituted hundreds of mW in a pulse. 3 refs.; 4 figs.

15798 (LA-UR—89-48) **On the use of multiple photon processes in krypton for laser guiding of electron beams.** Radziemski, L.J.; Khambatta, N.M.; Oertel, J.A.; Silk, R.; Mack, J.M.; Mitrovich, D. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 9p. (CONF-890145—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006546/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

Neutral krypton atoms were excited from the ground state $4p^6\ ^1S_0$ to the $4p^5\ 6p[3/2]_2$ state by a resonant two-photon absorption from a line-narrowed ArF excimer laser operating at 193.41 nm. A third photon, absorbed while the atom is in the excited state, ionizes it. Excited state and ion densities were theoretically computed using a standard rate-equation analysis. The irradiance levels used ($1 - 5 \times 10^8$ W/cm^2) were too low for significant ground and excited state ac Stark and Rabi effects. The photon detection system was calibrated with a standard tungsten lamp. Ion signals were measured with known electrical components. The resonance results were compared with predictions of non-resonant ionization based on a standard formulation. The ion and excited state densities have been used with a modified electron beam propagation code (IPROP) to model such propagation in a low pressure laser-excited krypton channel. The modifications included the effects to field ionization of the excited krypton atoms. Implications for guiding of e-beams using ArF excited krypton are discussed. 12 refs., 1 tab.

15799 (LBL-PUB—643-Rev.) **An ALS [Advanced Light Source] handbook.** (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 60p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006671/JAW.

This booklet aims to provide the prospective user of the Advanced Light Source with a concise description of the radiation a researcher might expect at his or her experimental station. The focus is therefore on the characteristics of the light that emerges from insertion devices and bending magnets and on how components of the beam lines further alter the properties of the radiation. The specifications and operating parameters of the ALS injection system and storage ring are of only peripheral interest. To this end, Sections 3 and 5 and most of Section 4 are devoted to summary presentations, by means of performance plots and tabular compilations, of radiation characteristics at the ALS--spectral brightness, flux, coherent power, resolution, time structure, etc.--assuming a representative set of four undulators and one wiggler and a corresponding set of five beam lines. As a complement to these performance summaries, Section 1 is a general introductory discussion of synchrotron radiation and the ALS, and Section 2 provides a compendious introduction to the characteristics of synchrotron radiation from bending magnets, wigglers, and undulators. In addition, Section 4 briefly introduces the theory of diffraction grating and crystal monochromators. 15 refs., 28 figs., 5 tabs.

15800 (SLAC-PUB—4822) **Disruption, beamstrahlung, and beamstrahlung pair creation.** Chen, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1988. Contract AC03-76SF00515. 10p. (CONF-8806243—31). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007542/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

The two major effects from the interaction of e/sup {minus}/e$^+$ beams---beamstrahlung and disruption---are reviewed, with emphasis on flat beam collisions. For the disruption effects we discuss the luminosity enhancement factor, the maximum and rms disruption angles, and the "kink instability". All the results are obtained from computer simulations, and scaling laws based on these are deduced whenever possible. For the beamstrahlung effects, we concentrate only on the final electron energy spectrum and the deflection angle associated with low energy particles. In addition to the generic studies on the beam-beam effects, we also list the relevant beam-beam parameters obtained from simulations on two sample designs: the TLC and the ILC. As an addendum, the newly discovered phenomenon of coherent beamstrahlung pair creation, together with the incoherent process, are discussed. 18 refs., 15 figs., 1 tab.

15801 (SLAC-PUB—4823) **Review of linear collider beam-beam interaction.** Chen, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 47p. (CONF-8707208—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007541/JAW.

From Physics of particle accelerators summer school; Batavia, IL, USA (20 Jul 1987).

Three major effects from the interaction of e$^+$e/sup {minus}/ beams---disruption, beamstrahlung, and electron-positron pair creation---are reviewed. For the disruption effects we discuss the luminosity enhancement factor, the maximum and rms disruption angles, and the "kink instability". All the results are obtained from computer simulations. Scaling laws for the numerical results and theoretical explanations of the computer acquired phenomena are offered wherever possible. For the beamstrahlung effects we concentrate only on the final electron energy spectrum resulting from multiple photon radiation process, and the deflection angle associated with low energy particles. For the effects from electron-positron pair creation, both coherent and incoherent processes of beamstrahlung pair creation are discussed. In addition to the estimation on total number of such pairs, we also look into the energy spectrum and the deflection angle. 17 refs., 23 figs., 1 tab.

15802 **Nonlinear spin acceptance in electron storage rings.** Kewisch, J.; Rossmanith, R.; Limberg, T. (CEBAF, Newport News, Virgina 23606). *Physical Review Letters;* **62**: No. 4, 419-421(23 Jan 1989).

It is shown that the degree of polarization of a beam in electron storage rings can be limited by nonlinear effects. The strength of a nonlinear effect depends on the amplitude of the particles. Particles performing synchrotron and betatron oscillations with high amplitudes can contribute over proportionally to depolarization. As a result, the emittance of a beam is not allowed to exceed certain boundaries, otherwise the beam will become more and more depolarized. This limit is called nonlinear spin acceptance.

15803 **An ultraviolet gas-loaded free-electron laser.** Reid, M.B. (NASA Ames Research Center, Moffett Field, CA (US)); Pantell, R.H. (Dept. of Electrical Engineering, Stanford Univ., Stanford, CA (US));. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **25**: No. 1, 84-87(Jan 1989).

By loading an FEL's wiggler cavity with hydrogen gas, it is possible to tune the FEL to below 130 nm, just above the electronic resonance of molecular hydrogen. The change in wavelength results from the refractive index of the gases, which alters the phase velocity of the wave and so modifies the synchronism condition. Using the parameters of the TRW wiggler on the beamline of the Stanford Superconducting Accelerator, as given in Table I of the text, this FEL can be tuned from 500 to 130 nm with a pressure ranging from 0 to 55 torr. The calculated electronic gain varies between 5.6 and 11 percent over this wavelength interval, comparable to the gain in vacuum.

15804 **Experimental investigation of nonlinear dynamics in the Fermilab Tevatron.** Chao, A.; Johnson, D.; Peggs, S.; Peterson, J.; Saltmarsh, C.; Schachinger, L.; Meller, R.; Siemann, R.; Talman, R.; Morton, P.; and others. (SSC Central Design Group, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 24, 2752-2755(12 Dec 1988).

The nonlinear dynamics of transverse particle oscillations in the Tevatron is studied experimentally and compared with prediction. Accurate measurements of various phase-space features are obtained. A theoretically expected metastable state of the accelerator, with particles captured on nonlinear resonance islands, is demonstrated experimentally, and stability of the state is investigated.

15805 **Experimental demonstration of wake-field effects in dielectric structures.** Gai, W.; Schoessow, P.; Cole, B.; Konecny, R.; Norem, J.; Rosenzweig, J.; Simpson, J. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **61**: No. 24, 2756-2758(12 Dec 1988).

We have measured the wake fields induced by short, intense relativistic electron bunches in a slow wave structure consisting of a dielectric-lined tube, as a test of the dielectric wake-field acceleration mechanism. These fields were used to accelerate a second electron bunch which followed the driving bunch at a variable distance. Results are presented for different dielectrics and beam intensities and are compared with theoretical predictions.

15806 **PARMILA: An overview.** Boicourt, G.P. (Los Alamos National Laboratory, Los Alamos, NM 87545, USA). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 1-21(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

A tutorial overview of the drift tube linac beam dynamics code, PARMILA, is presented. Its structure and operation are described and its origins and applications are reviewed briefly. A major application, the evaluation of the effects of errors in construction and deviations from design operating conditions, and the extent to which these effects can be addressed by Parmila are discussed briefly. The user friendliness, accuracy, options in the code, and improvements to the code are described. References to this material are provided for the benefit of the reader.

15807 **PARMTEQ: A beam-dynamics code fo the RFQ linear accelerator.** Crandall, K.R.; Wangler, T.P. (AccSys Technology, Inc., P. O. Box 5247, Pleasanton, CA 94566). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 22-28(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The PARMTEQ code is used for generating the complete cell design of a radio-frequency quadrupole linear accelerator and for multiparticle simulation of the beam dynamics. We present a review of the code, with an emphasis on the physics used to describe the particle motion and the cell generation.

15808 **LTRACK: Beam-transport calculation including wakefield effects.** Chan, K.C.D.; Cooper, R.K. (Los Alamos National Laboratory, Los Alamos, NM 87545, U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 37-44(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

LTRACK is a first-order beam-transport code that includes wakefield effects up to quadrupole modes. This paper will introduce the readers to this computer code by describing the history, the method of calculations, and a brief summary of the input/output information. Future plans for the code will also be described.

15809 **Recent applications of SUPERFISH.** Gluckstern, R.L.; Neri, F. (Physics Department, University of Maryland, College Park, MD 20742). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 105-108(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The program, SUPERFISH, obtains the frequencies and fields for azimuthally symmetric TM or TE modes in azimuthally symmetric cavities. The r-z plane is covered by a triangular mesh and the resulting difference equations for the field component H/sub phi/(TM) or E/sub phi/(TE) at the vertices of the mesh solved by direct matrix inversion. In the present paper, we describe a number of recent modifications of SUPERFISH. (AIP)

15810 **Interactive interface to the beam optics code "TRANSPORT".** Silbar, R.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 109-116(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The Fortran code, TRANSPORT, used for calculating beam optics properties, has been converted to run on a Symbolics Lisp Machine. Using the rich graphics and object-oriented programming environment provided by the KEE expert system shell, a beam designer can now use TRANSPORT in a manner similar to that of a user of a CAD/CAM tool or a spreadsheet. Beamline elements can be modified, added, or deleted at the user's screen, with the changes in the beam ellipses, envelopes, and transfer matrices being re-computed and re-displayed within a few seconds.

15811 **Status and future of the 3D MAFIA group of codes.** Ebeling, F.; Klatt, R.; Krawzcyk, F.; Lawinsky, E.; Weiland, T.; Wipf, S.G.; Steffen, B.; Barts, T.; Browman, J.; Cooper, R.K.; and others. (Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, D-2000 Hamburg 52, Germany). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 117-130(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The group of fully three dimensional computer codes for solving Maxwell's equations for a wide range of applications, MAFIA, is already well established. Extensive comparisons with measurements have demonstrated the accuracy of the computations. A large numer of components have been designed for accelerators, such as kicker magnets, non cyclindrical cavities, ferrite loaded cavities, vacuum chambers with slots and transitions, etc. The latest additions to the system include a new static solver that can calculate 3D magneto- and electrostatic fields, and a self consistent version of the 2D-BCI that solves the field equations and the equations of motion in parallel. Work on new eddy current modules has started, which will allow treatment of laminated and/or solid iron cores excited by low frequency currents. Based on our experience with the present releases 1 and 2, we have started a complete revision of the whole user interface and data structure, which will make the codes even more user-friendly and flexible.

15812 **Three-dimensional electromagnetic particle codes and applications to accelerators.** Manofsky, A. (Science Applications International Corporation, McLean, VA 22102). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 137-160(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

We discuss the principles of three-dimensional electromagnetic particle-in-cell plasma simulation codes. Applications of these codes to present-day accelerator problems involving high intensity particle beams and cold testing of complex RF structures are presented.

15813 Numerical limits on P.I.C. simulation of low emittance transport. Haber, I.; Rudd, H. (Naval Research Laboratory, Washington, DC 20375). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 161-172(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

Use of P.I.C. codes to simulate low emittance, high current transport can be limited by the collisional emittance growth which is a consequence of the relatively small number of particles in a simulation, in contrast to the much larger numer in an actual charged particle beam. Simulations are presented which show examples of the scaling of this collisional emittance growth. A knowledge of this scaling can be useful in discriminating between the collective physics which is under investigation and effects which are numerical in origin, without doing extensive numerical tests for each new parameter regime.

15814 Magnetic optics design (A designer's view of the beam transport environment). Heighway, E.A. (Los Alamos National Laboratory, MS-H808, Los Alamos, NM, 87545). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 181-203(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

This paper attempts to give a view of the beam transport and magnetic optics environment from the designer's perspective. It points to the many successes that have taken place in the last few years in the number and diversity of codes available and to the improvement in the physics content and capabilities of these codes. It also points to the lack of innovation in the way we access these codes and how we cope with their diversity; it pleads for an emphasis to be placed on the need for similar progress in the area of their human interface. As a lead to the community, a concept for a particular interface is presented.

15815 Optics code development at Los Alamos. Mottershead, C.T.; Lysenko, W.P. (AT-3, MS H808, Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 220-227(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

This paper is an overview of part of the beam optics code development effort in the Accelerator Technology Division at Los Alamos National Laboratory. The aim of this effort is to improve our capability to design advanced beam optics systems. The work reported is being carried out by a collaboration of permanent staff members, visiting consultants, and student research assistants. The main components of the effort are building a new framework of common supporting utilities and software tools to facilitate further development. research and development on basic computational techniques in classical mechanics and electrodynamics, and evaluation and comparison of existing beam optics codes, and support for their continuing development.

15816 Nonlinear beam dynamics in a funnel for combining two intense ion beams. Whealton, J.H.; Raridon, R.J.; Rothe, K.E.; Becraft, W.R.; Owens, T.L. (Oak Ridge National Laboratory, P.O. Box 2009, Oak Ridge, Tennessee 37831-8071). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 228-260(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The concept of funnels was introduced over the last few years with an endeavor to increase the beam intensity by combining two beams in the following fashion:

15817 Self-consisent transfer maps for beams with space charge using Lie algebraic methods. Ryne, R.D. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 265-274(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

We present a new approach to doing beam transport calculations in the presence of space charge. The approach is based on the self-consistent computation of transfer maps. In the linear approximation, the maps are represented by matrices. For the general case, the maps are represented and computed using Lie algebraic methods. This new approach is particularly useful for computing tunes and aberration coefficients in the presence of space charge.

15818 Differential algebraic treatment of beam dynamics to very high orders including applications to spacecharge. Berz, M. (SSC Central Design Group, Universities Research Association, c/o Lawrence Berkeley Laboratory, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 275-300(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The new method of Differential Algebra for the description of beam dynamics is presented. Differential Algebra allows a very efficient and elegant computation of transfer maps of accelerators, spectrometers and beam guidance systems. Contrary to existing techniques, the order of procedure is unlimited; in practice, maps of up to eleventh order have been computed.

15819 Analytical solution of single particle equations of motion to high orders: The formula manipulator HAMILTON and the fifth order code COSY 5.0. Berz, M.; Wollnik, H. (SSC Central Design Group, Universities Research Association, c/o Lawrence Berkeley Laboratory, Berkeley, Ca 94720, and II. Physikalisches Institut, 6300 Gieben, West Germany). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 301-312(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The custon made formula manipulator HAMILTON is presented. HAMILTON was written for the purpose of obtaining analytical formulas for aberration coefficients of particle optical elements to very high orders. For reasons of speed, HAMILTON was written in FORTRAN.

15820 Algorithms for the self-consistent simulation of high power klystrons. Eppley, K. (Stanford Linear Accelerator Center, Stanford, California, 94309). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 313-323(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

We discuss an improvement to the algorithm developed by Yu[1] for modelling rf cavities in klystrons using the port approximation. In this method, the cavity is simulated by imposing an rf voltage as a boundary condition across the outer wall. The voltage and phase are chosen to be consistent with the cavity impedance and with the rf current induced by the electron beam. In the original method, each cavity was calculated successively using either linear theory or an iterative method to achieve a self-consistent voltage. The new method relaxes the voltage and phase of several cavities simultaneously during the simulation. The time dependence of the voltages are calculated from a relaxation equation. The new algorithm reduces the total computation time by about a factor of five for a complete klystron.

15821 Moment invariants for particle beams. Lysenko, W.P.; Overley, M.S. (Los Alamos National Laboratory, AT-3, MS H808, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 323-335(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The rms emittance is a certain function of second moments in 2-D phase space. It is preserved for linear, uncoupled (1-D) motion. In this paper, we present new functions of moments that are invariants for coupled motion. These invariants were computed symbolically using a computer algebra system. Possible applications for these invariants are discussed. Also, approximate moment invariants for nonlinear motion are presented.

15822 **Summary for the working group on linac codes.** Wangler, T.P.; Staples, J. (Los Alamos National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **177**: No. 1, 347-350(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

The linac codes group discussed two main topics: (1) the PARMTEQ codes and their environment and (2) limitations of the linac simulation codes.

15823 **A soft x-ray streak camera using a microchannel plate photocathode.** Kapteyn, H.C.; Craig, W.W.; Power, G.D.; Schachter, J.; Falcone, R.W. (Dept. of Physics, Univ. of California, Berkeley, CA (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

The authors present data characterizing an x-ray streak camera which uses a microchannel plate as a photocathode. The microchannel plate provides good sensitivity to soft x-ray photons and adjustable gain in addition to one dimensional spatial imaging. The streak camera was used in conjunction with a high sensitivity CCD camera and a computer data acquisition system. The resulting detection system has single photon sensitivity, a time resolution of better than 200 psec, and a dynamic range exceeding 10/sup 3/.

15824 **Multi-channel optical streak cameras.** Jaanimagi, P.A.; Duff, J.; Gregory, G.G.; Keck, R.L.; Richardson, M.C.; Seka, W.; Bowley, D.J.; Majumdar, S.; Wright, J. (Lab. for Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

The accurate characterization of high-power multi-beam laser systems requires an optical streak camera system having a linear dynamic range of 1000. In this paper the authors wish to show that the classic definition of streak camera dynamic range tells very little about the system linearity. A problem of flare in the recording system limits the linearity to <100. Data from two commercial streak camera systems is presented.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 15787, 16531

15825 **(BNL—42090) The internal bunch coordinate monitor (IBCM).** Yamin, S.P. (Brookhaven National Lab., Upton, NY (USA)). 4 Nov 1988. Contract AC02-76CH00016. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89006106/JAW.

An instrument has been developed and installed at the AGS for recording the transverse motion of each rf bunch. It can be operated from any node of the Apollo control system. A preliminary version of this report has appeared elsewhere. Appendix A is an instruction manual. Two digitizers, running off the same 100 MHz clock, sampled the output of either a horizontal or vertical pick-up electrode (PUE) pair. The coordinate of each rf bunch was calculated each time it passed the PUEs during a 320 microsecond interval. Thus, the motion of each bunch could be followed during this interval. Subsequent analysis computed the Fourier transform of this motion. Bunch motion has been studied at several times during the AGS cycle: the betatron oscillations induced by the tune meter's vertical kick have been seen, and their Fourier analysis gives results consistent with the tune meter; at transition, the effect of the radial kick on each bunch has been observed; coupled-bunch oscillations have been studied; and instabilities produced by high intensities have been observed. 6 figs., 1 tab.

15826 **(BNL—42095) Magnetic measurements on insertion devices at NSLS.** Decker, G.; Galayda, J.; Kitamura, M.; Solomon, L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 19p. (CONF-8808141—11). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006182/JAW.

From 3. international conference on synchrotron radiation instrumentation; Tokyo, Japan (29 Aug 1988).

Magnetic measurements on three insertion devices for use in the NSLS x-ray ring are described. Hall probes were used for field mapping, and rotating long coils were used to determine integrated multipole coefficients. Results are presented for an iron pole-REC hybrid undulator, a vanadium permendur pole-REC wiggler and a 5 Tesla superconducting wiggler. 6 refs., 8 figs., 2 tabs.

15827 **(CEA-CONF—9416) Energy loss spectrometer for GANIL.** Gastebois, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). 1987. 5p. (In French). (CONF-8711282—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756641/JAW.

From 73. SFP Meeting; Paris, France (24 Nov 1987).

A high resolution magnetic spectrometry facility is described. The possibility to carry out measurements around the direction of incident ions (about 0 deg) in very favourable background noise conditions, with great accuracy and high efficiency is emphasized. Experiment examples are quoted: measure of elastic and inelastic scattering angular distributions with 0.05 deg angular resolution; study of giant resonances and their probability of deexcitation by gamma emission; transfer reactions of one or more nucleons; and measurement of the masses of exotic nucleon rich nuclei, with an accuracy of 0.000005.

15828 **(CEA-CONF—9419) Fabrication and tests and RF control of the superconducting resonators of the Saclay heavy ion LINAC.** Cauvin, B.; Coret, M.; Fouan, J.P.; Girard, J.; Girma, J.L.; Leconte, P.; Lussignol, Y.; Moreau, R.; Passerieux, J.P.; Ramstein, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). 1987. 9p. (CONF-870955—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756642/JAW.

From 3. workshop on RF superconductivity; Argonne, IL, USA (14 Sep 1987).

Two types of niobium superconducting resonators used in the Saclay linac are discussed. The outer cylinder and RF ports are identical for the two designs, but internal structures are different: full wave helix with three gaps behavior; or half wave with two gaps behavior. All cavities (34 full wave, 16 half) were tested for field and mounted in the machine cryostats. Cavity fabrication and performance are summarized. Vibration tests and Rf control are described. It is argued that helix resonators can overcome problems due to vibration. The very low lock out time percentage measured in an acceleration test with 21 cavities supports this confidence.

15829 **(CONF-880713—1) Collective ion acceleration in a localized ion source system.** Yao, R.L.; Rhee, M.J.; Fine, T.A.; Destler, W.W.; Striffler, C.D. (Maryland Univ., College Park (USA)). 1988. Contract AC05-85ER40216. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005396/JAW.

From Beams '88: 7th international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

The acceleration of ions to many times the electron beam energy when an intense relativistic electron beam is injected through a localized ion source into an otherwise evacuated drift tube has been theoretically and experimentally studied. We present a simple picture of the acceleration process obtained using a simulation code as well as recent experimental results. 3 refs., 7 figs.

15830 (DOE/ER/13788—2) The chirped-pulse free-electron laser: Final technical report, September 1987--October 1988. Moore, G.T. (New Mexico Univ., Albuquerque (USA). Center for Advanced Studies). Jan 1989. Contract FG04-87ER13788. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006792/JAW.

This is the final report of a theoretical and numerical investigation into the operation of pulsed free-electron lasers in which the electron energy depends on the time of injection into the wiggler. Such energy "chirping" over each of a train of electron micropulses injected into an FEL oscillator is expected to give rise to a laser pulse inside the optical resonator with a chirped carrier frequency ω/sub s/({tau}).

15831 (FNAL/C—88/195) Second generation superconducting super collider dipole magnet cryostat design. Niemann, R.C.; Bossert, R.C.; Carson, J.A.; Engler, N.H.; Gonczy, J.D.; Larson, E.T.; Nicol, T.H.; Ohmori, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1988. Contract AC02-76CH03000. 6p. (CONF-890102—15). NTIS, PC A02 - OSTI. Order Number DE89006145/JAW.

From ASME energy-sources technology conference and exhibition and 7. intersociety cryogenic symposium; Houston, TX, USA (22 Jan 1989).

The SSC Magnet Development Program is developing accelerator dipole magnets in successive iterations. The initial iteration is complete with six full length model magnets and a thermal model having been built and tested. This initial experience along with the evolving SSC Magnet System Requirements have resulted in the second generation magnet cryostat design. It is this configuration that will be employed for the near term ongoing magnetic, thermal, string and accelerated life testing and will be the design considered for Phase I; i.e., Technology Orientation, of the SSC Magnet Industrialization Program. 5 refs., 7 figs., 1 tab.

15832 (FNAL/C—88/197) Superconducting super collider second generation dipole magnet cryostat design. Niemann, R.C.; Bossert, R.C.; Carson, J.A.; Engler, N.H.; Gonczy, J.D.; Larson, E.T.; Nicol, T.H.; Ohmori, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1988. Contract AC02-76CH03000. 5p. (CONF-880812—35). NTIS, PC A02 - OSTI. Order Number DE89006143/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

The Superconducting Super Collider, a planned colliding beam particle physics research facility, requires {approximately}10,000 superconducting devices for the control of high energy particle beams. The {approximately}7,500 collider ring superconducting dipole magnets require cryostats that are functional, cryogenically efficient, mass producible and cost effective. A second generation cryostat design has been developed utilizing the experiences gained during the construction, installation and operation of several full length first generation dipole magnet models. The nature of the cryostat improvements is presented. Considered are the connections between the magnet cold mass and its supports, cryogenic supports, cold mass axial anchor, thermal shields, insulation, vacuum vessel and interconnections. The details of the improvements are enumerated and the abstracted results of available component and system evaluations are presented. 8 refs., 11 figs.

15833 (FNAL-TM—1553) T type collimator. LaVallie, E.; Smith, G.; Sorenson, D.; Volk, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1989. Contract AC02-76CH03000. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006572/JAW.

The Research Division has developed a pin-hole collimator capable of attenuating the 800 GeV proton beam by a factor of ten to one hundred. A bid package has been let for the first prototype and has been sent out. The other four collimators will be ordered in the spring of 1989. 3 refs., 2 figs., 3 tabs.

15834 (JINR—9-87-668) Diode line scanner for beam diagnostics. Gustov, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705556/JAW.

The device-scanning diode line is described. It is applied for beam profile measuring with space precision better than +- 0.5 mm and with discreteness of 3 mm along Y-axis and 0 ?.5 mm along X-axis. The device is easy in construction, reliable and has a small time of information acquisition (2-5 min). The working range is from 100 to 10/sup 6/ rad/min (10/sup 6/-10/sup 10/ part/mm/sup 2//s for 660 MeV protons). Radioresistance is 10/sup 7/ rad. The device can be applied for precise beam line element tuning at beam transporting and emittance measuring. The fixed diode line (a simplified device version) has smaller dimensions and smaller time of data acquisition (2-5 s). It is applied for quick preliminary beamline tuning. The flowsheet and different variants of data representation on beam profile are given. 4 refs.; 9 figs.

15835 (JINR—9-88-115) Investigation of the effect of additional anode on the characteristics of the arc multiple-charged ion source. Bogomolov, S.L.; Kutner, V.B.; Tret'yakov, Yu.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705557/JAW.

Submitted to the Organizing Committee of the 14-th Summer school and International Symposium on Ionized Gas Physics, August 1988, Saraevo, Yugoslavia.

A multiple charged ion source with a heated cathode and electron oscillation in the magnetic field was investigated. An additional anode with a potential differing from that of the main cathode by ΔU value has been introduced into the ion source. The plasma regions, adjacent to the anodes, get the potentials close to those of anodes and, consequently, in the plasma column the stationary electric field E-vector, perpendicular of magnetic field, is created. The action of the crossed electrical and magnetic field plasma particles caused their directed motion to the emission slit. The influence of the potential of the additional anode on the intensity and charge composition of ion beam extracted and on the discharge regime are studied. the 2-5 factor increase in total ion current and in the current of some charges was observed. Measurements of the potentials of the plasma region adjacent to the main and additional anodes at different potentials of additional anode have been carried out. The fluxes of plasma particles emitted from the discharge and their space distriution have been measured at different potentials of the additional anode. 4 refs.; 6 figs.

15836 (LBL—26005) Design of a 9 T 5 cm bore dipole. Taylor, C.E.; Caspi, S. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 4p. (CONF-8806243—27). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006605/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

A conceptual design is presented for an accelerator dipole magnet intended for a collider application with central field of 9T and a coil bore diameter of 5 cm. Emphasis is on identifying a superconducting cable and a coil design that requires little development and which will result in a reasonable operating "margin." Conventional NbTi superconducting cable is used, operating at 2 K to increase the critical current density. The cable and strand proposed are similar to designs now being manufactured for the SSC and the Tevatron. 4 refs., 9 figs., 1 tab.

15837 (LBL—26253) Status of LBL/LLNL FEL [free electron laser] research for two beam accelerator applications. Hopkins, D.B.; Sessler, A.M. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 20p. (CONF-8806258—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006656/JAW.

From Workshop on physics of linear colliders; Capri, Italy (13 Jun 1988).

For this workshop, we review the status of free electron laser (FEL) research being conducted at LBL and LLNL as part of a broader program of research on two beam accelerators (TBAs). We discuss measurements made on high power 35 and 138 GHz FELs and their problem areas. Experience with 35 GHz accelerator section fabrication is summarized. Induction accelerator-driven FELs for use as power sources for high-gradient accelerators are discussed, along with preliminary cost estimates for this type of

power source. Finally, a promising new version of an FEL/TBA is discussed. 22 refs., 7 figs., 5 tabs.

15838 (SLAC-PUB—4843) Low emittance thermionic electron guns. Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 11p. (CONF-8707208—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005944/JAW.

From Physics of particle accelerators summer school; Batavia, IL, USA (20 Jul 1987).

This paper discusses the following topics in electron guns: self fields; external fields; thermal-emittance-limited guns; and guns for electron linacs. 20 refs., 3 figs.

15839 (UCRL—21142) Pulsed high-current electron source: Final report. Spindt, C.A. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006775/JAW.

The objective of this investigation was to investigate ways to realize the cathode's potential as a source for high power pulse operation. The questions that needed to be studied were those of large area coverage, maximum emission that the cathode arrays are capable of producing practically, uniformity of emission over large areas, and the ability to operate with high voltage anodes. 9 figs.

15840 Electron ray tracing programs for gun design and beam transport. Herrmannsfeldt, W.B. (Stanford Linear Acclerator Center, Stanford University, Stanford, CA 94309). *AIP (American Institute of Physics) Conference Proceedings;* 177: No. 1, 45-58(1 Dec 1988). (CONF-880175—).

From Workshop on HEQ and TSC; Livermore, CA, USA (25 Jan 1988).

Computer simulation of electron and ion sources is made by using a class of computer codes known as gun design programs. In this paper, we shall first list most of the necessary and some optional capabilities of such programs. Then we will briefly note specific codes and/or authors of codes with attention to specialized applications if any. There may be many more such programs in use than are treated here; we are only trying to cover a range of examples, not perform a comprehensive survey.

4304 Storage Rings

REFER ALSO TO CITATION(S) 15644, 15658, 15671, 15802, 16348

44 INSTRUMENTATION

15841 (JINR-R—10-87-793) Hardware and software of the universal modular PROM, EPROM and PAL programmer. Efimov, L.G.; Enkbold, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705566/JAW.

The description of the system developed for PROM LSI7s programming is given. Unlike other known programmers the system allows one to operate with a wide set of most popular MOS and dipolar PROM, EPROM, PAL devices; to expand the actual variety of programmed LSI's on the basis of modular programmer structure, inside which removable memory type - oriented cards are connected to a main CAMAC module through its special 1/0 port; to use the advanced RT-11 operating system-based software in the mode of work on-line with MERA-60 ("Electronika-60") or LSI-11 microcomputer; to accomplish the programming in an autonomous mode without using and industrial computer or other source of program control; this mode is provided by built-in processor board working under INTEL 8085 microprocessor control. 6 refs.; 6 figs.

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 15098, 15601, 15634, 15707, 15713, 15790, 15826, 15898, 15998, 16142, 16226, 16346, 16618, 16630, 16653, 16747, 16795

15842 (AD-A—200249/1/XAB) ESR (electron spin resonance) and spin trapping of free radicals produced in poly U and /poly A using the boron-neutron capture reaction. Carmichael, A.J.; Arroyo, C.M.; Moore, M.L. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1988. 6p. (AFRRI-SR—88-11). NTIS, PC A02/MF A01.

Pub. in International Jnl. of Radiation Applications and Instrumentation, Part C, Vol. 32, No. 2, 227-231(1988).

Powdered samples of poly U and poly A containing sodium tetraborate and controls without tetraborate were irradiated at room temperature with thermal neutrons. Radical formation occurred only in the samples containing tetraborate. Thermal neutrons interact with ^{10}B (10% naturally occurring in tetraborate) via the boron-neutron capture reaction. This reaction generates alpha particles and ^{7}Li ions with mean kinetic energies of 1.48 and 0.85 MeV, respectively. The identification and location of the free radicals produced by the interaction of these particles with poly U and poly A, was determined by ESR and spin trapping using the spin trap 2-methyl-2-nitrosopropane (MNP). Following dissolution of irradiated poly U in an MNP solution, the spin-trapped poly U was hydrolyzed with base (NaOH, pH 12.6). On readjusting the pH to pH 7.5, the spin-adduct ESR spectrum showed that in poly U, radical formation occurs at the C(6) carbon of the uracil residues. For poly A the solid-state ESR spectrum suggests that radicals are formed at the N(3) and/or N(7) nitrogens and at the C(4) and/or C(5) carbons. However, only the C(5) carbon-centered radicals were spin trapped. In addition, the results for poly A indicate that sugar-phosphate backbone is disrupted by the alpha particles and 7Li ions. The nature of this interactions is still unclear.

15843 (BNL—42222) The use of TPC's as target region detectors in the MPS. Foley, K.J. (Brookhaven National Lab., Upton, NY (USA)). 2 Dec 1988. Contract AC02-76CH00016. 4p. (CONF-880862—12). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006176/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

15844 (CIEMAT—616) Counting efficiency for radionuclides decaying by beta and gamma-ray emission. Grau, A.; Garcia-Torao, E. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 44p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756333/JAW.

In this paper, counting efficiency vs figure or merit for beta and gamma-ray emitters has been computed. It is assumed that the decay scheme has only a gamma level and the beta-ray emission may be coincidsent with the gamma-rays or the internal-conversion electrons. The radionuclines tabulated are: ^{20}O ^{20}F, ^{28}Al, ^{35}p, ^{41}Ar, ^{42}K, ^{47}SE, ^{62}Fe, ^{66}Cu, ^{81}Ge, ^{86}Rb, ^{104}Rh, ^{108}Ru, ^{112}Pd, $^{121}Sn(m)$, ^{122}In, ^{129}I, ^{141}Ce, ^{132}Pr, ^{151}Sm, ^{170}Tm, ^{171}Tm, ^{194}Os, ^{203}Hg, ^{205}Hg, ^{210}Pb, ^{225}Ra, $^{244}Am(m)$. It has been assumed that the liquid is a toluene based scintillator solution in standard glass vials containing 10 cm^3.

15845 (DOE/ER/40369—1) Development of the calorimeter trigger for the ZEUS detector. Smith, W.H. (Columbia Univ., New York (USA)). [1988]. Contract AC02-87ER40369. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006491/JAW.

The purpose of this research was to begin development of the trigger for the calorimeter of the ZEUS detector at HERA, a new storage ring that will provide collisions between 820 GeV protons and 30 GeV electrons by 1990. The calorimeter will be made of depleted uranium plates and plastic scintillator read out by wavelength shifter bars into 12,000 photomultiplier tubes. These signals will be combined into 1000 towers with separate electromagnetic and hadronic sums. The calorimeter first level trigger will be pipelined with a decision provided 5 μsec after each beam crossing, oc-

curring every 96 nsec. The trigger will need to determine the total energy, the total transverse energy, the missing energy, and the energy and number of jets and isolated electrons. The trigger rate needs to be held to 1 kHz against a rate of proton-beam gas interactions of 200 kHz. The summed pulseheights will be digitized by 8-bit flash ADC's. They will be linearized, stored and manipulated digitally. The various pipelined sums will be made using ECL and CMOS technology.This grant was used to investigate these technologies, model the trigger performance, and begin the design. This research will be continued by this principal investigator under another DOE grant at the University of Wisconsin.

15846 **(FNAL-TM—1551) Studies of the LBL CMOS integrated amplifier/discriminator for randomly timed inputs from fixed target experiments.** Russ, J.S.; Yarema, R.J.; Zimmerman, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1988. Contract AC02-76CH03000. 6p. (CONF-881103—30). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006571/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

A group at Lawrence Berkeley Laboratory has reported an elegant CMOS VLSI circuit for amplifying, discriminating, and encoding the signals from highly-segmented charge output devices, e.g., silicon strip detectors or pad readout structures in gaseous detectors. The design exploits switched capacitor circuits and the well-known time structure of data acquisition in colliding beam accelerators to cancel leakage effects and switching noise. For random inputs, these methods are not directly applicable. However, the high speed of the reset switches makes possible a mode of operation for fixed target experiments that uses fast resets to erase unwanted data from random triggers. Data acquisition in this mode has been performed. Details of operation and measurements of noise and rate capability will be presented. 8 refs., 6 figs.

15847 **(FRCEA-TH—177) Definition and production of calibration standard neutron sources for radiation protection device calibration.** De Matos, E. (Toulouse-3 Univ., 31 (France)). 1987. 250p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756444/JAW.

To improve the characterization of radioprotection devices performances, it would be advisable to calibrate these devices in neutron spectra which are nearly like those met in practice (nuclear reactors, plutonium technology laboratories...). The purpose of this work is, in a first time, to choose the nature and the dimensions of the different shields used to achieve broad typical neutron spectra extending to lower energies from a 14.8 MeV neutron beam. The second step is the evaluation of spectral distribution and calculation of associated dosimetric quantities. For that, several spectrometric techniques are employed: on one hand, activation detectors and Bonner spheres method named rough spectrometry; on the other hand, an accurate spectrometry which uses recoil proton counters. The dosimetric quantities, especially the value of kerma deduced from these spectra must be in good agreement with those measured with a tissue equivalent ionization chamber.

15848 **(GSI—88-56(prepr.)) Self-quenching streamer-tube detectors in the WA80 experiment.** Albrecht, R.; Bock, R.; Claesson, G.; Gutbrod, H.H.; Hoffmann, J.; Kolb, B.W.; Kopf, U.; Loos, A.; Lund, I.; Marquardt, M. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lund Univ. (Sweden); Muenster Univ. (Germany, F.R.)). Oct 1988. 19p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

The copious production of charged particles in nucleus-nucleus collisions at SPS energies necessitated new technical solutions for charged-particle measurements. We describe the construction and performance of the streamer-tube detectors used in the experiment WA80 at CERN. Special attention is given to the developed electronic readout system with serial transmission of data from more than 40 000 readout pads. About 100 events per beam spill were collected during data taking. For each even the full angular information is recorded for charged particles with polar angles: 2/ sup 0/ $< \theta <$ 28/sup 0/.

15849 (IA—1440, pp 277-279) **Improving a system for measuring radionuclides in the human body.** Levinson, S.; Assido, H.; Piestun, S.; Ronen, Y. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15850 (IA—1440, pp 320-321) **Application of a BaF/sub 2/ scintillator to γ-ray spectroscopy.** Gayer, A.; Rapaport, M.S. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15851 **(IFVE-OEA—88-70) Microprogrammable controller for data readout from drift chambers.** Govorun, V.N.; Davidenko, A.M.; Sytin, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705478/JAW.

The auxilliary controller for data readout, processing and recording in the buffer memory module from drift chambers electronics is described. The controller is based on microprogrammable control scheme. The module structure scheme, its working algorithms and some operating characteristics are presented. 5 figs.; 5 refs.

15852 **(IFVE-OEF—88-74) Single-electron characteristics of small size photomultipliers.** Grachev, O.A.; Ronzhin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705479/JAW.

Submitted to the journal Instrum.Exp. Tech. .

Results of measuring single-electron spectra, the amplification factor of the dinode system and the noise level for the small-sized PMs, FEU-58, FEU-60, FEU-68, FEU-85, FEY-86, FEU-102, FEU-147 are presented. 6 refs.; 3 figs.; 2 tabs.

15853 **(IFVE-OEF—88-89) Identification of signals obtained from scintillators with different decay constants with help of time-matching circuit to mathematical gravity centre of pulses.** Borog, V.V.; Dronov, V.V.; Lapshin, V.G.; Rykalin, V.I. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705480/JAW.

The circuit for time-matching to the pulse mathematical centre of gravity to identify the pulse shape of the phoswich type scintillation crystals used to nuclear spectrometry has been first employed. Calculations which allo one to determine the optimal time for signal analysis with the shaper for various types of poswich crystals are presented. Experimentally obtained coefficients of spectra separation for single crystals are in a good agreement with theoretical estimations and make up 5 for the NaI(Tl) and CsI(Na) crystals and 8- for the CsI(Tl) crystals. Time and amplitude expermental spectra obtained from the CsI(Na) crystal are also presented. Further improvement of peak separation of time distributions from different crystals using this type of the shaper has been considered. 10 refs.; 8 figs.

15854 **(IFVE-OEF—88-105) Structure and data presentation in the data acquisition system for the SFINKS device.** Kul'man, N.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705482/JAW.

The aim of the paper is to create a convenient system to describe the data structure coming from the data acquisition electron-

ics. A language to describe the data structure to accordance with the setup detectors which allows one to make changes in the processing system with the changes of the setup configuration has been proposed. The inner presentation is realized in the form of trees in the ZBOOK system, widely used in high energy physics. Events are treated according to the description and are in the ZBOOK banks. The data are written on the tape in the computer-independent EP-format. 6 refs.

15855 **(INFN-TC—88-29) Time of flight system based on low pressure multiwire proportional counters for accelerator mass spectrometry.** Bonetti, R.; Fioretto, E.; Schiatti, S. (Istituto Nazionale di Fisica Nucleare, Milan (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705505/JAW.

Two Low-Pressure Multiwire Proportional Counters acting as Start and Stop detectors in a time of flight system have been built and tested. The intrinsic resolution at an isobutane pressure of 0.35-1 torr is about 450 ps for alpha particles and about 200 ps for heavy ions.

15856 (INIS-mf—11348, pp 103) **Design and construction of a vacuum chamber for counting alpha particles.** Macias D, A.; Lugo R, J.F. (Universidad Autonoma de Zacatecas (Mexico). Mantenimiento y Diseno de Equipo; Universidad Autonoma de Zacatecas (Mexico). Centro Regional de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15857 (INIS-mf—11348, pp 97) **Preparation and dosimetry properties of high sensibility thermoluminescent material.** Azorin, J.; Gutierrez, A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

15858 (INIS-mf—11351, pp 72-77) **Build up curves and Awall correction factor in /sup 60/Co beams.** Kovar, I.; Novotny, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Dozimetrie Zareni). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Measurements were made on two different /sup 60/Co beams and for two cylindrical ionization chambers (Baldwin Farmer 2505 and VAK 252.1). The method is stated of the calculation of the correction factor A/sub wall/ from growth curves. The dependence of the relative ionization flow on the thickness of the wall and the lid for both ionization chambers is represented. A comparison is made of the measured and calculated values of A/sub wall/ in dependence on the thickness of the wall and lid, of correction factor A/sub wall/, coefficient of attenuation μ and the dependence of collision kerma β/sub 1/ on the field size. (E.S.). 6 figs., 1 tab., 10 refs.

15859 (INIS-mf—11351, pp 77-82) **Pitfalls in in-vivo dosimetry with thermoluminescence dosemeters.** Ganchev, M. (Meditsinska Akademiya, Sofia (Bulgaria)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The equipment is described of TL dosimetry usable for experiments. TL material used was a Harshow thermoluminescent detector type TLD-100 in powder form or in form of rods. Experiments were used to assess certain effects which may influence the interpretation of results. Discussed were (1) the effect of the TL detector form (powder, rods) which is manifested by the shift of TL curves in dependence on initial temperature, (2) the effect of instruments on the evaluation of calibration curves (the incidence of superlinearity, the rise in the height of peak with increased temperature), (3) the effect of irradiation equipment on the determination of the calibration curve. (E.S.). 7 figs., 1 tab., 2 refs.

15860 (INIS-mf—11351, pp 92-98) **Passive detectors for fast neutron therapy beams.** Spurny, F. (Ceskoslovenska Akademie Ved, Prague. Ustav Dozimetrie Zareni). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Thermoluminescent detectors (TLD's) and solid-state nuclear track detectors (SSNTD's) were used for the measurement. The detectors were irradiated with beams of different sources of monoenergetic and polyenergetic neutrons. The relative response was monitored to fast neutrons of detectors Al/sub 2/O/sub 3/, CaSO/sub 4/, /sup 7/LiF and Al-P glass and the effect of polyethylene and teflon packings of some TL detectors. The response of SSNT detectors was monitored in dependence on the type of leaching and detector material. An example is given of the application of passive detectors for determining the dependence of track density on depth in the irradiated phantom. (E.S.). 3 figs., 4 tabs., 12 refs.

15861 (INIS-mf—11351, pp 173-177) **Spectrometry of X-rays from 10 to 300 keV.** Pernicka, F. (Ceskoslovenska Akademie Ved, Prague. Ustav Dozimetrie Zareni). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A system was designed for measuring X-ray spectra based on the use of a crystal or a semiconductor detector. The system with an NaI crystal was designed for energy of less than 100 to 150 keV and for measuring mainly scattered radiation. The crystal used (thickness of 0.5") allows to ignore the Compton scattering and the penetration of photons. The resolution and response of the NaI detector were determined and the X-ray spectrum for the TF 250 tube was measured by a Stabilipan instrument (voltage 80 kV, current 10 mA, inherent filtration 1.8 mm Al). The system with the semiconductor detector makes use of a GeLi detector (thickness 5.5 mm, dia. 9 mm). Its resolution is 680 keV for 60 keV photons. The system is designed for measuring X-ray beams with an energy of 10 to 300 keV. The measured effect of the photopeak is in good agreement with theoretical assumptions. The Siemen's Monopan was used for measuring X-ray spectrum (60 kV, 2 mA, filtration 0.15 mm Cu). (E.S.). 6 figs., 3 tabs., 3 refs.

15862 (INIS-mf—11351, pp 86-92) **Heavy charged particle dosimetry, theory and application.** Hansen, J.W. (Risoe National Lab., Roskilde (Denmark)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Experiments were made to verify the theory of the transport of heavy particles through a medium using L-α-alaline for the detection of radiation. The dose response of L-α-alaline was measured for X-ray radiation of an energy of 4 to 16 MeV, electron radiation of an energy of 6, 10 and 20 MeV, low-LET radiation, 16 MeV and 6 MeV protons, 20 MeV particles and other charged particles. Of the measured dose responses RE values were experimentally obtained and compared with calculated results. Free and very stable radicals were obtained by radiation. Fading of low-LET and high-LET radiation was determined as induced by the said radicals. Using ESR spectra it was found that diverse chemical reactions take place in the track of high-LET particles. However, chemical reactions in the track of a heavy charged particle will be the same if the medium is homogeneously irradiated with low-LET radiation. (E.S.). 7 figs., 1 tab., 11 refs.

15863 (INIS-SU—68, pp 556) **Definition of isotope activity by the method of different multiplicity gamma-cascade intensity detection.** Berestov, A.V.; Martsynkevich, B.A.; Khil'manovich, A.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15864 (INIS-SU—68, pp 580) **Optimization of the process of drift equalization in Si(Li) detectors.** Bajzakov, B.B.; Radzhapov, S.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15865 (INIS-SU—68, pp 594) **Multichannel system for nuclear reaction studies.** Vodin, A.N.; Khomyakov, G.K.; Nemashkalo, B.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15866 (INIS-SU—68, pp 601) **Silicon detector of charged particles operating at atmospheric pressure.** Zalinkevich, V.A.; Konfino, B.Z.; Shcherbakov, G.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15867 (INIS-SU—68, pp 603) **X-ray and gamma spectrometers on base of semiconductor detectors.** Lupilov, A.V.; Gorodenkin, S.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15868 (INIS-SU—68, pp 609) **General expression for a peak asymmetry coefficient in an amplitude spectrum.** Samedov, V.V.; Stolyarova, E.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15869 (INIS-SU—68, pp 602) **Large-area silicon surface-barrier detectors of alpha particles with improved energy resolution.** Konovalova, G.A.; Lashaev, S.I.; Shcherbakov, G.M.; Skakodub, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15870 (INIS-SU—68, pp 536) **Radiation dose counter on photodiodes.** Bogatov, V.N.; Kovtun, V.E.; Cherkasov, A.S.; Shevchenko, A.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15871 (INIS-SU—68, pp 549) **Study on high-effective Ge(Li)-detectors made in IYaI AN Ukrainskoj SSR and applied in sample radioelement analysis.** Gavrilyuk, V.I.; Kirnas, I.G.; Kupryashkin, V.T.; Petrosyan, Eh.E.; Pashchuk, N.N.; Petrenko, N.S.; Polyanskij, A.L.; Nederya, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15872 (INIS-SU—68, pp 563) **Charge collection properties of the surface of inlet window in the (p-i-n) structures of DIN-1.** Muminov, R.A.; Malaeva, V.T.; Nurbaev, K.M.; Oksman, M.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15873 (INIS-SU—68, pp 605) **Background properties of germanium units for X-ray detection.** Danengirsh, S.G.; Lupilov, A.V.; Sokolov, A.D. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15874 (INIS-SU—68, pp 610) **Mean value, dispersion and asymmetry coefficient for distribution function of charge induction process in ionization detectors with homogeneous field.** Samedov, V.V.; Stolyarova, E.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

15875 **(IPEN-PUB—207) Energy dependence of an ionization chamber with parallel plates in standard gamma and x-radiation fields.** Batistella, M.A.; Caldas, L.V.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 15p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705549/JAW.

The characteristics of low energy X-radiation standard fields were determined and the energy dependence of a ionization chamber of the superficial type, with parallel plates and fixed volume, normally utilized in the dosimetry at the Radiotherapy level was studied. The possibility of adaptation of this chamber type for use in gamma radiation dosimetry was verified. Different thickness Lucite build-up caps, from 2.0 up to 5.5 mm, were produced and tested in /sup 60/Co and /sup 137/Cs gamma radiation fields. This type of detector, with the adequate build-up cap, presented a performance comparable to that of the thimble type ionization chamber. It was concluded that it is not necessary to use different kinds of chambers for each high and mean energy interval. The superficial chamber, specially produced to detect low energy X-radiation, may be adapted to detect gamma radiation.

15876 **(JINR—13-87-828) Investigation of some characteristics of FEU-143 photomultipliers in gaseous threshold Cherenkov counters.** Gavrishchuk, O.P.; Shalygin, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705559/JAW.

The FEU-143 photomultiplier was studied in a gaseous threshold. Cherenkov counter at the electron beam of 3.5 GeV/c momentum. Comparative characteristic with FEU-139 and XP-2020/Q is presented. As a result of measurements spectral characteristics of photomultipliers were defined, their one-electron spectra were shown. Constant of counter for FEU-143 was determined as 118 1/cm, for FEU-139 as 95 1/cm, for XP-2020/Q as 126 1/cm. It characterizes the optical properties of the counter. Using on FEU-143 and FEU-139 of ultraviolet radiation film shifters which increase the amplitude of FEU signal by a factor of 1.8 is shown. 6 refs.; 3 figs.; 1 tab.

15877 **(JINR—13-88-126) Investigation of a possibility of application of Ni/SiO/sub 2/ adsorbent to long time diffusion purification of xenon- and methan mixture.** Zanevskij, Yu.V.; Peshekhonov, V.D.; Smykov, L.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705560/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

The possibility of application of Ni/SiO/sub 2/ adsorbent for long duration purification of xenon in gas filled detectors was investigated. It is shown that diffusion purification of xenon and its mixtures by means of Ni/SiO/sub 2/ allows to keep the level of electronegative impurities of approximately 10-15 ppm by O/sub 2/ during a long time. The method of diffusion purification is simpler than the force purification, though for achievement of very low levels of electronegative impurity content the force method is preferable. 2 refs.; 5 figs.

15878 **(JINR—13-88-130) Event selection equipment in experiment on the study of μ/sup +/μ/sup -/-pair production at the magnetic spectrometer with a streamer chamber.** Adam, D.; Bannikov, A.V.; Behm, Ya. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705561/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

The trigger used in the experiment with a streamer chamber magnetic spectrometer on the beam of negative charged particles at 38 GeV/c(1x10/sup 6/ part/s) from the Serpukhov accelerator is described. The production of μ/sup +/ν/sup -/ pairs in π/sup -/-carbon interactions was studied in this experiment. The use of the digital processing of information from the scintillator hodoscopes, including parallel branching to six independent flows, made it possible to decrease the background level to 1 event/s and at the same time to retain high efficiency of registration of the dimuon events with a streamer chamber. The trigger delay time was ~ 220 ns. The trigger electronics was made using ECL integrated circuits of K500 series and it occupies three CAMAC crates. 12 refs.; 12 figs.

15879 **(JINR-D—1-88-83) Investigations of the characteristics of the DELPHI hadron calorimeter prototype.** Filatova, N.A.; Golovatyuk, V.M.; Kadyrov, R.B. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705562/JAW.

Submitted to the journal Nucl. Instrum. Methods.

The characteristics of the DELHI hadron calorimeter prototype in various modes of operation of its detectors are presented in this paper. It is shown that the transition to a saturated proportional mode and use of more sensitive electronics do not make worse the hadron calorimeter operation. The possibility to select muon tracks in the hadron calorimeter and to use them for detector triggering has been investigated. The results of nuclear shower simulation in the detector are presented. The form of the dependence between signals from the electromagnetic and hadron calorimeters has been found out. The supposition to improve the procedure of the hadron energy reconstruction with the help of the discovered function has been made. 11 refs.; 17 figs.

15880 **(JINR-E—13-87-309) Combined scintillation and track technique to search for $\beta\beta$-decay.** Akimov, Yu.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705563/JAW.

Submitted to the journal NIM.

A variant of the scintillation spectrometer with wire chambers for $\beta\beta$-decay search is considered. The time-of-flight technique for background suppression is suggested. The (-3 m/sup 2/) source placed in the centre of the facility comprises three planes. Four wire chambers measure particle tracks in the centre of the source. The whole volume is filled with helium. Scintillation counters are produced of long plates. Four plates form a counter with two fast photomultipliers on both edges. Electron time-of-flight between the scintillators makes up 2-5 ns. If the mass of the (/sup 150/Nd) source is equal to 75 g, then the half-decay period may be measured T/sub 1/2/=10/sup 22/ years. 6 refs.; 1 fig.

15881 **(JINR-R—6-88-100) Program system for processing of spectra obtained on the multidetector correlation device (MUK).** Venos, D.; Adam, J.; Hnatowicz, V.; Honusek, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705564/JAW.

A program system used by evaluation of multidimensional coincidence spectra is described. The spectra recorded on magnetic tapes are obtained by means of multidetector correlation device (MUK). The angular correlation coefficients A/sub 22/ and A/sub 44/ for the given cascades of gamma transitions are the final result of the calculations. The system operates in DOS/ES system of the EC-1040 computer with the 1024 Kbyte memeory. All the codes are written in fortran language. 8 refs.; 5 figs.; 1 tab.

15882 **(JINR-R—7-88-89) Investigation of charge multiplication in semiconductor detectors using /sup 40/Ar ion beam.** Kushniruk, V.F.; Guin' Tkhi Kha; Tsyganov, Yu.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705565/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

The charge multiplication in silicon surface barrier detectors has been investigated experimentally using /sup 40/Ar beam. The dependences of mutiplied pulse height amplitudes, the asymmetry of distributions and of the fraction of multiplied signals on the maximum electric field strength are obtained. It is shown that the pulse heights, the fraction of multiplied pulses and the asymmetry of distributions are linear function of the electric field. The experimental results are discussed on the basis of the mechanism of avalanche multiplication of current carriers in strong electric fields taking into account the dynamics of carrier motion in the electron-hole track. 11 refs.; 7 figs.

15883 **(K/QT—250) High-resolution position-sensitive proportional counter camera for radiochromatographic imaging.** Schuresko, D.D.; Kopp, M.K.; Harter, J.A.; Bostick, W.D. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1988. Contract AC05-84OT21400. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006370/JAW.

A high-resolution proportional counter camera for imaging two- dimensional (2-D) distributions of radionuclides is described. The camera can accommodate wet or dry samples that are separated from the counter gas volume by a 6-μm Mylar membrane. Using 95% Xe-5% CO_2 gas at 3-MPa pressure and electronic collimation based upon pulse energy discrimination, the camera's performance characteristics for ^{14}C distributions are as follows: active area--10 by 10 cm, position resolution--0.5 mm, total background--300 disintegrations per minute, and count-rate capability--10^5 disintegrations per second. With computerized data acquisition, the camera is a significant improvement in analytical instrumentation for imaging 2-D radionuclide distributions over present-day commercially available technology. (Note: This manuscript was completed in July 1983). 13 refs., 10 figs.

15884 **(LA—11495-MS) Measurements and calculations of the response of large single-element scintillators to neutrons at energies between 25 and 200 MeV.** Byrd, R.C.; Sailor, W.C.; Yariv, Y. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 10p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006472/JAW.

Because neutrons are uncharged, their detection usually involves organic scintillators that use nuclear reactions on hydrogen and carbon to produce charged particles. The energy deposited by these particles in the scintillator results in detectable light production. This paper uses results reported in recent papers to describe

the operation of neutron detectors at energies below 200 MeV. 4 refs., 8 figs.

15885 **(LBL—26307) An IC-compatible detector process.** Holland, S. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 10p. (CONF-881103—37). NTIS, PC A02 - OSTI. Order Number DE89006650/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

A silicon radiation-detector fabrication process which exploits the excellent gettering properties of a backside layer of phosphorus-doped polysilicon has been developed and characterized. 2 mm diameter p-i-n diodes have been fabricated with typical reverse-bias current densities of approximately 1 nA/cm^2. In addition, a strip detector with 128 strips of 6 mm length on a 55 μm pitch has been successfully fabricated with better than 10% uniformity in the diode reverse-bias currents. The process is compatible with conventional integrated-circuit fabrication technologies, and p-channel enhancement and depletion-mode MOS-FETs with associated inter-device isolation have been fabricated simultaneously on detector-grade silicon with p-i-n radiation detectors. 28 refs., 9 figs.

15886 **(LBL—26386) Germanium blocked impurity band infrared detectors.** Rossington, C.S.; Haller, E.E. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 7p. (CONF-880870—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006607/JAW.

From 4. international conference on infrared physics; Zurich, Switzerland (22 Aug 1988).

Germanium blocked impurity band (BIB) photoconductors have been fabricated and characterized for responsivity, dark current, and noise equivalent power. BIB photoconductors theoretically provide an extension of the spectral response, a reduction in sensitivity to cosmic radiation and a reduction in noise characteristics compared with conventional photoconductors. Silicon BIB detectors have been successfully developed by researchers at Rockwell International, which do indeed meet their theoretical potential. In the proper configuration, these same Si BIB detectors are capable of continuous detection of individual photons in the wavelength range from 0.4 to 28 μm. Until the BIB concept was developed, detection of individual photons was only possible with photomultiplier tubes which detected visible light. Due to the successes of the Si BIB detectors, it seemed natural to extend this concept to Ge detectors, which would then allow an extension of the spectral response over conventional Ge detectors from {approximately}100 μm to {approximately}200 μm. 8 refs., 2 figs.

15887 **(UCRL—99067) Innovative techniques for x-ray calorimetry.** Labov, S.; Silver, E.; Landis, D.; Madden, N.; Goulding, F.; Beeman, J.; Haller, E.; Rutledge, J.; Bernstein, G.; Timbie, P. (Lawrence Livermore National Lab., CA (USA)). 19 Dec 1988. Contract W-7405-ENG-48. 6p. (CONF-8808164—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006731/JAW.

From International Astronomical Union colloquium 115; Cambridge, MA, USA (22 Aug 1988).

In our x-ray calorimetry effort, we have developed several techniques which may be helpful to other groups working in this field. We are studying several different monolithic and composite calorimeter designs. In our readout configuration, the preamplifier circuit employs negative voltage feedback which allows us to accurately measure the temporal profile of the thermal pulse produced by an x-ray absorbed in a micro-calorimeter. Rise times of less than two microseconds have been observed in monolithic devices operating at .3 K. Furthermore, the feedback preamplifier can be configured for either positive or negative electro-thermal feedback. This preamplifier system is followed by an analog pulse shaping amplifier with a frequency response that can be adjusted to yield the maximum signal to noise ratio for a given thermal response of the calorimeter. In addition, we have developed several diagnostic procedures which have been useful in determining the operating and noise characteristics of our devices. These include an infrared light-emitting diode which flashes a discrete amount of energy on to the calorimeter and a capacitively coupled test input to the preamplifier which allows us to directly determine the total noise in the thermal detection system. Finally, we are developing an adiabatic demagnetization refrigerator with a temperature control system that is designed to stabilize the 0.1 K cold stage to better than 8 μK. This is required for a resistive thermal detector with resolving power of 1000. 11 refs., 1 fig.

15888 **(ZfK—584, pp 56) Performance of silicon nuclear radiation detectors.** Borany, J. von; Bischoff, L.; Schmidt, B. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15889 **(ZfK—584, pp 54) Construction and performance of a large area ΔE-E silicon detector telescope.** Deutscher, M.; Foerster, R.; Mende, G.; Ortlepp, H.G.; Seidel, W. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15890 **(ZfK—584, pp 55) Capacity model of a silicon strip detector.** Teichfuss, M.; Bischoff, L. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15891 **(ZfK—584, pp 57) Two-dimensional position-sensitive photodetectors.** Schmidt, B.; Schott, H. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

15892 **Active spectral narrowing by dynamical optical means.** Csonka, P.L. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Journal of the Optical Society of America A: Optics and Image Science;* **6**: No. 2, 171-173(Feb 1989).

Dynamical optics can be used to alter the frequency spectrum of electromagnetic radiation. This can increase the intensity in a given narrow-frequency band. The method is useful when one deals with spectral purity $\lambda/\Delta\lambda > 10^5$. In addition, the method can also be used to shift the average frequency of electromagnetic radiation such as x rays.

15893 **Bioassay alpha spectrometry: energy resolution as a function of sample source preparation and counting geometry.** Ide, H.M.; Moss, W.D.; Gautier, M.A. (Los Alamos National Lab., NM (USA)). *Health Physics;* **56**: No. 1, 71-77(Jan 1989).

Alpha particle counting is based on the response of an electronic counting system to an incident alpha particle. Alpha spectrometry is used in our employee surveillance bioassay program to measure the concentration of isotopes of Am, Pu and U contained on sample source preparations. Nuclides of Am, Pu and U are separated from the sample matrix by anion exchange and are electroplated on a stainless steel disc. The plated source diameter is 12.7 mm. A tracer is added to the sample before anion exchange as a quality control procedure to provide a measure of chemical yield. Tracer alpha-particle emissions are recorded in a preassigned calibrated area of the energy spectrum and chemical recovery is calculated by the ratio of tracer counts per second divided by the tracer activity in becquerels (Bq). Percent tracer recovery may also be calculated by introducing the average counting efficiency factor in the denominator. Tracer yield is then used to provide a reliable estimate of the sample's analyte counts that are recorded in other preassigned energy dependent areas of the spectrum. The tracer spectrum in the presence or absence of other nuclides also provides evidence of the performance characteristics of the alpha spectrometer, for example, chamber vacuum and electronics. Electroplated samples are counted in any one of 96 detectors. The backgrounds of these detectors are maintained at less than 3 counts per 70,000 s over a 190 keV energy window to provide a limit of detection of less than 0.37 mBq per sample at the 95% confidence level. In this

paper, resolution of the photopeak is shown to be a function of the source to detector distance and a function of degraded alpha energies due to Fe or other extraneous materials on the plated surface.

15894 **Resolution limitations and optimization of the LLNL streak camera focus.** Lerche, R.A.; Griffith, R.L. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-473, Livermore, CA (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

The RCA C73435 image tube is biased at voltages far from its original design in the LLNL ultrafast (10 ps) streak camera. Its output resolution at streak camera operating potentials has been measured as a function of input slit width, incident-light wavelength, and focus-grid voltage. The temporal resolution is insensitive to focus-grid voltage for a narrow (100 μm) input slit but is very sensitive to focused grid voltage for a wide (2 mm) input slit. At the optimum wide-slit focus voltage, temporal resolution is insensitive to slit width. Spatial resolution is nearly independent of focus-grid voltage for values that give good temporal resolution. Both temporal and spatial resolution depend on the incident-light wavelength. Data for 1.06-μm light show significantly better focusing than for 0.53 μm light. Streak camera operation is simulated with a computer program that calculates photoelectron trajectories. Electron ray tracing describes all of the observed effects of slit width, incident-light wavelength, and focus-grid voltage on output resolution.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 15713

15895 **(IPEN-PUB—199) Influence of the scattering of beta, gamma and x-radiations by open window edges of dosimetric film badges.** Barbosa, M.V.; Caldas, L.V.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 13p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705545/JAW.

Agfa Gevaert films, used in personal monitoring by the Instituto de Pesquisas Energeticas e Nucleares (IPEN), were irradiated at different conditions in beta, gamma and X-radiation fields in order to determine correnction factors for the radiation scattering effect at the open window edges of dosimetric film badges. Although this effect has not been observed for beta radiation, there is a small contribution of it in the case of X and gamma radiations.

15896 **(LA-UR—89-295) Test of radiation hardness of CMOS transistors under neutron irradiation.** Sadrozinski, H.F.W.; Rowe, W.A.; Seiden, A.; Spencer, E.; Hoffman, C.M.; Holtkamp, D.; Kinnison, W.W.; Sommer, W.F. Jr.; Ziock, H.J. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 7p. (CONF-890247—2). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006511/JAW.

From 5. European symposium on semiconductor detectors: new developments on radiation detectors; Munich, F.R. Germany (21 Feb 1989).

We have tested 2 micron CMOS test structures from various foundries in the LAMPF Beam stop for radiation damage under prolongued neutron irradiation. The fluxes employed covered the region expected to be encountered at the SSC and led to fluences of up to 10^{14} neutrons/cm^2 in about 500 hrs of running. We show that test structures which have been measured to survive ionizing radiation of the order MRad also survive these high neutron fluences. 5 refs., 4 figs.

15897 **Damage resistance of coated optics.** Wadt, W.R. (Los Alamos National Lab. (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

Successful application of high energy lasers to national needs in strategic defense, inertial confinement fusion and isotope separation is contingent on the development of optical coatings that can withstand very intense radiation. Significant progress has been made in the development of damage resistant coatings over the past 15 years to support the needs of the inertial confinement fusion and isotope separation programs. However, the requirements evolving from the Strategic Defense Initiative (SDI) are much more severe and demand dramatic improvements in the performance of optical coatings beyond the current state of the art. The author presents the approach that he took at Los Alamos towards solving the problems of optical coatings for SDI.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 14199, 15103, 15571, 15680, 15718, 15720, 15768, 15769, 15770, 15773, 15825, 16031, 16263

15898 **(CONF-8808186—1) New directions in spectroscopy for the analytical electron microscope.** Zaluzec, N.J. (Argonne National Lab., IL (USA)). Aug 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005824/JAW.

From 4. annual analytical electron microscopy conference; Tokyo, Japan (30 Aug 1988).

The concept of using the transmission electron microscope as a high spatial resolution microcharacterization laboratory is now well established, and AEM has been extremely successful over the last decade in solving problems in materials science. Rather than review past accomplishments we shall instead address the topic of the new spectroscopies in the AEM suggesting directions which may develop into fruitful methodologies in the near future. 8 refs., 5 figs.

15899 **(DOE/ER/13696—2) Vibrational control of chemical reactors: Selectivity enhancement, stabilization and improvement of transient behavior: Progress report for the period April 1, 1988--March 31, 1989.** Cinar, A. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). Dec 1988. Contract FG02-87ER13696. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005901/JAW.

In this project, the effects of vibrational control on stabilization and improvement of transient behavior of tubular packed-bed chemical reactors and on selectivity and yield improvement in complex chemical reactions are studied. During the second year of the project, a numerical singularity analysis technique has been developed and applied to the open-loop and feedback controlled CO oxidation reactor. The technique is applicable to various kinds of reactor systems and reactions, and it can be used to classify their qualitatively different static bifurcation behaviors. The technique is being extended to analyze and classify the bifurcation behavior of the reactor system under vibrational control. A reduced-order model of the CO oxidation reactor has been developed and used in the vibrational-feedback control studies. Procedures for developing low order vibrational-feedback controllers are being investigated. To study selectivity and yield improvement by vibrational control, numerical and experimental vibrational control studies have been conducted using the ethylene oxidation reaction in an isothermal internal recycle reactor. Forced vibrations in inlet concentration and/or total flow rate have not caused any appreciable improvement in the selectivity and yield of ethylene oxidation. Effects of periodic operation on the nonisothermal internal recycle reactor are being investigated. 7 refs., 1 fig.

15900 **(DOE/ID/12726—T1) Advanced moisture sensor research and development: Quarterly progress report.** Nicholls, C. (Southwest Research Inst., San Antonio, TX (USA)). 31 Jan 1988. Contract FC07-88ID12726. 6p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006502/JAW.

During the third quarter of this program we have collected data to enable the design of our sensor, designed the sensor and the

test plan. Thus Tasks 1a through 2c have been completed. We have submitted the test plan for DOE approval prior to continuing. The long delay in finding a suitable industrial collaborator has required us to request a six month no-cost time extension, as was anticipated in the previous quarterly report. 2 figs.

15901 (IA—1440, pp 172) **Weighing aerosols in an electrodynamic chamber.** Bar-Ziv, E.; Olim, M.; Mond, M.; Ben-Dor, G. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15902 **(LBL—25207) Computer controlled drifting of Si(Li) detectors.** Landis, D.A.; Wong, Y.K.; Walton, J.T.; Goulding, F.S. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 9p. (CONF-881103—33). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006709/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

A relatively inexpensive computer-controlled system for performing the drift process used in fabricating Si(Li) detectors is described. The system employs a small computer to monitor the leakage current, applied voltage and temperature on eight individual drift stations. The associated computer program initializes the drift process, monitors the drift progress and then terminates the drift when an operator set drift time has elapsed. The improved control of the drift with this system has been well demonstrated over the past three years in the fabrication of a variety of Si(Li) detectors. A few representative system responses to detector behavior during the drift process are described. 4 refs., 5 figs.

15903 **(LBL—25694) Low capacitance large volume shaped-field germanium detector.** Luke, P.N.; Goulding, F.S.; Madden, N.W.; Pehl, R.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 20p. (CONF-881103—35). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006659/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

A large volume (150 cm^3) germanium detector with a full-depletion capacitance of only ~1 pf has been fabricated. The effect of impurity space-charge was utilized to obtain an appropriate electric field distribution in the detector so that carriers are collected on a small area electrode. Detectors based on this principle are capable of very low noise operation and have immediate applications in direct detection dark matter particle experiments. Detector pulse shapes and carrier trapping effects were also examined for possible applications involving higher energy radiations. 9 refs., 10 figs.

15904 **(LBL—26317) Particle detection with semiconductor thermistors at low temperatures.** Wang, N.; Beeman, J.; Cleland, A.N.; Cummings, A.; Lange, A.; Ross, R.; Sadoulet, B.; Steiner, H.; Shutt, T.; Wellstood, F.C. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 7p. (CONF-881103—32). NTIS, PC A02 - OSTI. Order Number DE89006665/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

We have studied the use of neutron transmutation doped (NTD) Ge thermistors as phonon sensors at dilution refrigerator temperatures. In addition to measuring their thermal and electrical properties, we have observed pulses generated by X-rays incident on a thermistor thermally well-clamped to a heat sink. We find that during these pulses the lattice temperature of the thermistor apparently does not change. This surprising result is interpreted as evidence of a strong coupling between the high energy phonons generated by the interaction and the charge carriers in the thermistor. Additionally, these phonons appear to be absorbed within a fraction of a millimeter. We conclude that these thermistors have several desirable properties for a good high energy phonon sensor. It remains to be seen, however, if a composite detector consisting of a large crystal and attached phonon sensors can be developed. 15 refs., 9 figs.

15905 **(LBL—26440) Discrete analysis of stochastic NMR.** Wong, Sam Tak-Sum. (Lawrence Berkeley Lab., CA (USA)). Dec 1988. Contract AC03-76SF00098. 120p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007016/JAW.

Stochastic NMR is an efficient technique for high field in vivo imaging and spectroscopic studies in cases where the peak rf power required may be prohibitively high for conventional pulsed NMR techniques. This dissertation presents a theoretical analysis of a stochastic NMR method of acquiring spectroscopy data. The spin system is excited with rf pulses where the flip angles or the phases of the pulses are samples of a discrete stochastic process. The method is formulated as a stochastic difference equation which is then converted to ordinary deterministic difference equations describing the input-output cross-correlation, average signal power and signal power spectrum. The solutions of these equations are used to evaluate the stochastic, technique in terms of peak rf power requirement, spectral distortions and signal-to-noise ratio. Experimental results are also presented which verify the results of the discrete analysis. The analysis shows that the maximum signal-to-noise ratio is achieved when the RMS flip angle is approximately the Ernst angle. When the RMS flip angle is below the Ernst angle, the input-output cross-correlation is a good estimate of the FID. Increase of excitation power causes line broadening. In addition, the use of random flip angle, fixed phase excitation causes a notch artifact and non-uniform response across the spectrum both of which are not found in two new types of excitation, the random phase excitation and the random quadrature excitation. The signal power spectrum is also a good estimate of the real spectrum. The approximation of the cross-correlation by a time average causes systematic noise. The amount of systematic noise is found to be significantly reduced when an entire maximum length sequence (MLS) is used for excitation. Noise-like distortion at high power MLS excitation is discovered to be related to the number of feedback paths in the MLS generator. 29 refs., 58 figs.

15906 (N—89-13330, pp 136) **IR-dust observations of Comet Tempel 2 with CRAF VIMS.** Combi, M.R.; McCord, T.B.; Bell, J.F.; Brown, R.H.; Clark, R.N.; Cruikshank, D.P.; Johnson, T.V.; Lebofsky, L.A.; Matson, D.L. (Jet Propulsion Lab., Pasadena (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Measurement strategies are now being planned for using the Visual and Infrared Mapping Spectrometer (VIMS) to observe the asteroid Hestia, and the nucleus, and the gas and dust in the coma of comet P/Tempel 2 as part of the Comet Rendezvous Asteroid Flyby (CRAF) mission. The spectral range of VIMS will cover wavelengths from 0.35 to 5.2 micrometers, with a spectral resolution of 11 nm from 0.35 to 2.4 micrometers and of 22 nm from 2.4 to 5.2 micrometers. The instantaneous field of view (IFOV) provided by the foreoptics is 0.5 milliradians, and the current design of the instrument provides for a scanning secondary mirror which will scan a swath of length 72 IFOVs. The CRAF high resolution scan platform motion will permit slewing VIMS in a direction perpendicular to the swath. This enables the building of a two dimensional image in any or all wavelength channels. Important measurements of the dust coma will include the onset of early coma activity, the mapping of gas and dust jets and correlations with active nucleus areas, observations of the dust coma from various scattering phase angles, coverage of the low wavelength portion of the thermal radiation, and the 3.4 micrometer hydrocarbon emission. A description of the VIMS instrument is presented.

15907 (N—89-13330, pp 186) **NASA Infrared Telescope Facility Comet Halley monitoring program 2: Post-perihelion results.** Tokunaga, A.T.; Golisch, W.F.; Griep, D.M.; Kaminski, C.D.; Hanner, M.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The post perihelion results of a 1 to 20 micrometer infrared monitoring program of Comet Halley are presented. These results

complement previous observations of the pre-perihelion passages of Halley. The observations cover the time period of Mar. 1986 to the present time. During the time the comet was observable, two or more observations were obtained per month. The most interesting results were: (1) a detectable change in the J-H and H-K colors of Halley, and (2) a search for a nucleus rotation at J during 20 Feb. to 10 Mar. was unsuccessful. The perihelion J-H and K-K colors were constant at 0.48 + or - 0.01 and 0.17, respectively. A preliminary reduction of the data is given. It is concluded that the colors were at first similar to pre-perihelion and then changed from July onward to be bluer and more similar to the solar colors. This suggests that a change may have occurred in the composition of the dust coma of Halley in July 1986.

15908 **(SAND—87-1850) Trajectory scoring in rectangular coordinates using transponder-interrogator range and range rate data.** Hollowell, J. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 247p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007005/JAW.

Range and range rate measurements taken from a transponder-interrogator ranging system are processed via an extended Kalman filter and an extended Kalman smoother to provide an accurate time-position history of a vehicle's trajectory by estimating the errors in the vehicle's inertial navigation system. The necessary equations are derived in rectangular coordinates. As such, they are only valid for low altitude flights over a small geographic area. The equations are implemented in a FORTRAN program which is used to process flight data gathered at Edgewood, NM. 5 refs., 65 figs., 3 tabs.

15909 **(UCRL—99364) Modeling the behavior of pulsed, high power microwave antenna systems.** Ziolkowski, R.W.; Barth, M.J.; Grant, J.B. (Lawrence Livermore National Lab., CA (USA)). 5 Aug 1988. Contract W-7405-ENG-48. 11p. (CONF-8805132—13). NTIS, PC A03 - OSTI. Order Number DE89006280/JAW.

From 4. national high power microwave conference; Monterey, CA, USA (9 May 1988).

In an attempt to quantify the performance of pulsed antenna systems, we have combined TSAR, a three-dimensional finite difference time domain electromagnetics modeling code, and MAXWELL3, the finite element counterpart of TSAR, with a general purpose near-to-far field transform post-processor FAR. TSAR and MAXWELL3 predict for a particular geometry the fields over a generally specified surface and the post-processor FAR then generates from these near-fields, the far-field time histories and/or the field patterns at particular frequencies via a Fourier transform. The application of these algorithms to modeling the overall antenna system performance when breakdown regions occur near the antenna is being studied and will be discussed. 3 refs., 4 figs.

15910 **Spherical sector electrostatic analyzers for measurements of energy and angular distributions.** DeSerio, R. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996, and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **60**: No. 3, 381-388(Mar 1989).

A method is presented for three-dimensional trajectory calculations of charged particles in a spherical sector electrostatic analyzer. The particle motion in the entrance and exit fringe fields for particular geometries is included. With the initial conditions as input (the analyzer voltages and the particle position and velocity as it enters the analyzer field), the trajectory calculation provides the following information: (1) the position of the particle as it exits the analyzer; (2) the velocity direction of the particle as it exits the analyzer; and (3) the radial extrema of the particle trajectory within the analyzer sectors. Functions (3) determine whether the particle strikes the analyzer electrodes, while functions (1) and (2) can by used for predicting the particle's position at any point after exiting the analyzer. Functions (2), here given for the first time, are especially useful for quantifying the response of the analyzer for position-sensitive detection of narrow angular distributions. These functions can be expressed as a Taylor series expansion in five variables which are simply related to the initial conditions. The expansion coefficients are given for a commercially available electron analyzer (Comstock Inc., 129 Valley Ct., Oak Ridge, TN 39812). The utility of the approach is demonstrated for determining its focusing properties, energy response, and energy-angle response.

15911 **Automated imaging and control system for the continuous determination of size and relative mass of single compositionally dynamic droplets.** Maloney, D.J.; Fasching, G.E.; Lawson, L.O.; Spann, J.F. (U.S. Department of Energy, Morgantown Energy Technology Center, P.O. Box 880, Morgantown, West Virginia 26507-0880). *Review of Scientific Instruments;* **60**: No. 3, 450-455(Mar 1989).

A novel droplet imaging system (DIS) has been developed which, when interfaced with an electrodynamic balance (EDB), offers unique capabilities for characterizing size, mass, density, and composition of single, compositionally dynamic droplets. The DIS employs a standard closed-circuit video camera as a droplet sensor. Real-time hardware image processing techniques are employed to extract cross-sectional area and position information from the video signals. The position information is used to generate a control signal which is proportional to the droplet mass. The DIS capabilities are demonstrated for evaporating water and coal-water slurry droplets. The results presented clearly demonstrate that this system can be applied to easily detect compositional variations from one droplet to another. Accurate estimates of droplet composition can be obtained with little knowledge of the starting composition. The DIS has a wide range of applications and is particularly valuable when applied to the study of multicomponent droplets where the physical and chemical behavior often times depends on the droplet composition.

15912 **New form of scanning optical microscopy.** Reddick, R.C.; Warmack, R.J.; Ferrell, T.L. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 767-770(1 Jan 1989).

The exponential decay of the evanescent field due to the total internal reflection (TIR) of a light beam in a prism is used to advantage in a new form of scanning optical microscope, the photon scanning tunneling microscope (PSTM). The PSTM is the photon analogue of the electron scanning tunneling microscope. The sample is placed on or forms the TIR surface and spatially modulates the evanescent field. Changes in intensity are monitored by a probe tip scanned over the surface, and the data are processed to generate an image of the sample. Subwavelength resolution in three dimensions is obtained because of the exponential nature of the evanescent field intensity. Images produced by a prototype instrument using 633-nm light and a 1-μm probe tip are shown to have a lateral resolution of about 200 nm.

15913 **(LA-tr—89-3) An achromatic super telephoto lens.** Takahashi, Yasuo. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. Translation of Japanese Patent Application 44-33399, April 30, 1969. 8p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006163/JAW.

First, the structure is explained. The first lens is a positive lens, the second lens is a negative lens, the third lens is a positive lens, the fourth through the sixth lenses are the combination of a negative, a positive and a negative lens, the seventh lens is a negative lens, the eighth lens is a negative lens, the ninth lens is a positive lens, the eighth and the ninth lenses are placed immediately next to each other. The lens by this invention is characterized by the function of the 3-ply lens placed in the middle. If the 3-ply lens is not placed there, then the whole lens system will become a telephoto lens consisting of the frontal group (three lenses) and the rear group (three lenses). 2 figs.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

15914 **(MLM—3558) Detection of the alpha and gamma polymorphs of HMX in beta-HMX by Raman spectroscopy.** Holy, J.A.; Firsich, D.W.; Walters, R.R. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 22 Dec 1988. Contract AC04-88DP43495. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007305/JAW.

The Raman spectra of powders of the beta-HMX (cyclotetramethylene- tetranitramine) polymorph containing 2 to 14% of the alpha- or gamma-HMX polymorphs have been measured. The Raman spectra of each polymorph contains over 40 peaks, but a beta phase peak at 361 cm/sup {minus}1/, an alpha phase peak at 1217 cm/sup {minus}1/, and a gamma phase peak at 1225 cm/sup {minus}1/ are sufficiently isolated from other peaks to be used for concentration measurements. The relatively strong intensities of the peaks indicate that concentrations on the order of 0.1% of alpha or gamma phases in the beta phase should be detectable. Applications of this technique have been qualification of a production batch of HMX and testing for polymorph conversion in aged pellets. 11 refs., 7 figs.

15915 **(MLM—3566(OP)) Laser ignition of energetic materials with a pulsed Nd:YAG laser.** Dosser, L.R.; Siwecki, S.A.; Beckman, T.M.; Girmann, T.C. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 1988. Contract AC04-88DP43495. 5p. (CONF-881244—5). NTIS, PC A02 - OSTI. Order Number DE89006861/JAW.

From LASERS '88; Lake Tahoe, NV, USA (5 Dec 1988).

The laser is an ideal ignition source for energetic materials. It permits precise control of the ignition energy, and parameters such as the ignition threshold and the time to ignition can be determined. Optical fibers are used to deliver the ignition pulse and to monitor the time required to complete the burn of the energetic material. The light emission from the interaction of the Q-switched pulse from the Nd:YAG laser with two secondary explosives, pentaerythritol tetranitrate (PETN) and 1,3,5-triaminotrinitrobenzene (TATB), has been spectrally resolved using a 0.25 m monochromator with an optical multichannel analyzer detector. These spectra show definite band structure, which indicates that these experiments may lead to an understanding of the ignition chemistry. 5 figs.

15916 **(UCRL—97701) Time resolved study of light emitted by detonation arrival at the surface of high explosives in various environments.** Bahl, K.L.; Von Holle, W.G. (Lawrence Livermore National Lab., CA (USA)). 24 Mar 1988. Contract W-7405-ENG-48. 7p. (CONF-880693—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005657/JAW.

From 19. international ICT conference on combustion and detonation; Karlsruhe, F.R. Germany (29 Jun 1988).

In search of a way to accurately measure time of arrival of detonation fronts, we have been using an electronic streak camera equipped with a light intensifier to record intensity-time histories of the light that is emitted when a detonation front emerges through the surface of high explosives in contact with various environments. Streak records at writing speeds up to 100 mm/μs were obtained of detonations in air, argon, water and vacuum when the high explosive (HE) was either bare or covered with materials such as: aluminum silicofluoride [$Al_2(SiF_6)_3$], PETN powder, polymethyl methacrylate (PMM), glass, aluminum foils, transparent tape, black ink, potassium chloride crystals, sodium chloride crystals and lithium fluoride crystals. The result of this study is that we believe that we can measure the time of arrival of a detonation front at a bare HE surface in air to within a few nanoseconds. 12 refs., 10 figs., 1 tab.

4502 Nuclear

15917 **(LA-UR—88-3750) Applying expertise to data in the Geologist's Assistant expert system.** Berkbigler, K.P.; Papcun, G.J.; Marusak, N.L.; Hutson, J.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-890304—12). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003463/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Geologist's Assistant combines expert system technology with numerical pattern-matching and online communication to a large database. This paper discusses the types of rules used for the expert system, the pattern-matching technique applied, and the implementation of the system using a commercial expert system development environment. 13 refs., 8 figs.

15918 **(SAND—86-1505) The Interagency Information Study Database System.** Harrison, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1986. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007300/JAW.

This report presents a detailed discussion of the Interagency Information Study Database System. A discussion of the Interagency Information Study and the Holland Strategic Systems Planning Methodology is given. The purpose for the writing of this software is presented and a discussion of the software design is given. The software installation procedure for an IBM Personal Computer XT is presented. A short user's guide is included to give the reader an understanding of the capabilities of the software and how to use it. Finally, conclusions are drawn about the suitability of the Interagency Information Study Database System for the support of the Interagency Information Study Project. It is concluded that the Interagency Information Study Database System is a flexible and powerful tool for use in supporting the Interagency Information Study Project. 6 refs., 11 figs.

15919 **"S" glass manufacturing technology transfer.** Buckner, D.A. (Monsanto Research Corp. Mound, Miamisburg, OH (US)); McCollister, H.L. (Sandia National Labs., Albuquerque, NM (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 233-236(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

A glass-ceramic-to metal sealing technology patented by Sandia National Laboratores, Albuquerque (SNLA) was developed by MRC-Mound for use in the manufacture of weapon components. Successful implementation attracted increasingly widespread weapon use of this technology. "S-glass" manufacturing technology was transferred to commercial vendors to ensure that weapons production schedules would be met in the coming years. Such transfer also provided sources of this fledgling technology for the Department of Defense (DOD), aerospace and other commercial uses. The steps involved in the technology transfer are described, from the initial cooperative development work of Sandia and Mound scientists and technologists to the final phase of qualifying commercial vendors for component manufacture.

4503 Explosion Detection

15920 **(UCID—21612) Deployment of the Oklahoma borehole seismic experiment.** Harben, P.E.; Rock, D.W. (Lawrence Livermore National Lab., CA (USA)). 20 Jan 1989. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006799/JAW.

This paper discusses the Oklahoma borehole seismic experiment, currently in operation, set up by members of the Lawrence Livermore National Laboratory Treaty Verification Program and the Oklahoma Geophysical Observatory to determine deep-borehole seismic characteristics in geology typical of large regions in the Soviet Union. We evaluated and logged an existing 772-m deep borehole on the Observatory site by running caliper, cement bond-

ing, casing inspection, and hole-deviation logs. Two Teledyne Geotech borehole-clamping seismometers were placed at various depths and spacings in the deep borehole. Currently, they are deployed at 727 and 730 m. A Teledyne Geotech shallow-borehole seismometer was mounted in a 4.5-m hole, one meter from the deep borehole. The seismometers' system coherency were tested and found to be excellent to 35 Hz. We have recorded seismic noise, quarry blasts, regional earthquakes and teleseisms in the present configuration. We will begin a study of seismic noise and attenuation as a function of depth in the near future. 7 refs., 18 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 14615

15921 **(N—89-12137) Report of the earth radiation budget requirements review.** (National Oceanic and Atmospheric Administration, Washington, DC (USA)). Jun 1988. 113p. (NOAA-TR-NESDIS—41; CONF-8703312—). NTIS, PC A06/MF A01.

From Earth radiation budget requirements review; Rosslyn, VA, USA (30 Mar 1987).

The exchange of radiative energy between the Sun, Earth and space affects the Earth's climate and is also affected by the Earth's climate. Theoretical models indicate that increases in manmade greenhouse gases, such as carbon dioxide, over decadal and longer time scales, perturbs the equilibrium between the two components of the Earth's radiation budget (ERB); i.e., (1) the heat Earth absorbs form the Sun, and (2) the heat Earth emits to space. This leads to changes in the global climate. For example, the 1983 report to the National Research Council entitled, Changing Climate (NRC, 1983), indicated that a doubling of carbon dioxide concentration was likely in the next hundred years. This would cause the Earth to emit less heat than it absorbs which would subsequently increase the globally averaged surface air temperature by between 1.5 and 4.5 C. This change would occur as a result of a small imbalance between the two ERB components of less than 1 W/sq m, globally averaged. However, these same models indicate that each component would be changed by up to 4 W/sq m, globally averaged, with regional changes varying from about 20 W/sq m in the tropics to as large as 100 W/sq m for absorbed solar radiation at the poles. These large regional changes would be due to the effects of climate feedback on the ERB components, caused primarily by increased water vapor and decreased surface snow and ice cover at the poles, both the result of the warmer climate. Thus, with a long, uninterrupted time record of stable ERB measurements, it would be possible to detect climate change associated with increases in trace gas concentrations.

15922 **(NP—9770213) Integration of chemical transformation processes into the determination of propagation in consideration of NO/sub x/ conversion in case of photochemical smog. Final report. Pt. 5. Application of a complex dispersion model to simulate a photochemical smog episode.** Stern, R.; Scherer, B. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Geophysikalische Wissenschaften; Umweltbundesamt, Berlin (Germany, F.R.)). Dec 1984. 370p. (In German). NTIS (US Sales Only), PC A16. Order Number DE89770213/JAW.

The Sai-Airshed model, a complex Eulerian photochemical dispersion model, has been used to simulate the oxidant concentration levels in the Rhine-Ruhr area during a selected photochemical smog episode. The results have been compared against ground level and flight measurements. Overall the model results are in good agreement with measured ozone values at urban and rural sites. Ozone maxima aloft, calculated downwind of the main emission areas, are predicted approximately 25% too low. Possible explanations are the model's instantaneous spread of point source NO-emissions into a grid cell or a too large vertical dispersion rate. Measured NO/sub x/-concentration levels are reproduced somewhat less successfully. Because the measurements are strongly influenced by local sources, the underestimation can be attributed to the averaging properties of the model's grid. In the second part of the study, the model has been used as a tool for determining the influence of different control regulations on the concentration levels. It could be shown that the emissions from outside of the modeled area have a large influence on the ozone concentrations in the Rhine-Ruhr area. For a 80% reduction of all anthropogenic hydrocarbon emissions the model calculates a 25% reduction of the ozone maxima downwind. NO/sub x/-reduction measures led to an increase of the ozone levels in large parts of the modelling area. In summary, based on the model calculations, hydrocarbon control seems to be the most effective strategy for decreasing the ozone levels. With 161 figs., 25 tabs., 32 refs.

15923 **(NP—9770236) Climate simulation with atmospheric models for time scales of months. Final report.** Heise, E.; Jacobs, W.; Ketterer, M.; Renner, V. (Deutscher Wetterdienst - Zentralamt, Offenbach am Main (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1988. 362p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE89770236/JAW.

Part I: The skill of numerical extended range predictions is up to now rather low in the mean and varies considerably from case to case. In addition, it suffers from systematic model errors (SME). For this reason considerable interest exists in methods to forecast the forecast skill and to correct for the SME. A series of forecasts with the ECMWF T21-model (as installed at the MPI/University in Hamburg) has been used to look for relationships between energetics and forecast skill and to investigate the SME and the time dependent energetics (also in relation to the results of a climate simulation). Relationships between the strength of baroclinic conversions and forecast skill - which might be useful for an a priori prediction of the latter - could be found (and also be verified in some T42-experiments done at the ECMWF). Significance and time development of the components of the SME have been documented and the limits of applicability of differently approximated error fields for the correction of independent forecasts have been investigated. Part II: Two major model components that up to now are normally oversimplified in general circulation or climate models are cloud cover and surface processes. Based on methods available at the German Weather Service, improvements were achieved. Cloud cover as well as the surface processes were parameterized in a physically more realistic way than before. Thus, especially the surface model now is better suited for use in climate models including climatic change experiments. (orig.) With 105 refs., 35 tabs., 118 figs.

15924 **(PNL-SA—16316) Aircraft operations and airborne measurement of perfluorotrimethylcyclohexane (PTCH) during ANATEX.** Lee, R.N.; Busness, K.M.; Stunder, B. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 5p. (CONF-890133—5). NTIS, PC A02 - OSTI. Order Number DE89006934/JAW.

From 6. joint conference on applications of air pollution meteorology; Anaheim, CA, USA (29 Jan 1989).

This paper describes PNL aircraft operations during the ANATEX field program and presents tracer concentration data obtained with the on-board analyzer for missions conducted on March 4, 1987. Also presented are preliminary sequential sampler data. Since final reduction of these data have not been completed, sequential sampler data have been normalized with respect to peak tracer loading to yield relative rather than absolute tracer concentrations in these sample. 3 refs., 7 figs., 2 tabs.

15925 **(PNL-SA—16318) Observed and modeled terrain-induced shear in tracer trajectories.** Doran, J.C.; Skyllingstad, E.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 16p. (CONF-890133—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006938/JAW.

From 6. joint conference on applications of air pollution meteorology; Anaheim, CA, USA (29 Jan 1989).

In this paper we discuss two cases in which surface observations provided generally similar wind field patterns but in which the winds aloft differed significantly. The differences, which are simulated well by a primitive equation model, are attributed to the

effects of terrain blocking, which is difficult to incorporate into objective interpolation schemes. Implications for plume trajectory predictions are also discussed. Our area of interest lies in a semi-arid region in southeastern Washington; for the numerical simulations we concentrated on a domain 100 by 100 km in size. The central, eastern, and northeastern portions of the region are relatively flat with only a gentle rise toward the northeast corner of the domain. The northwestern and southern regions have considerably more terrain relief, with ridge lines extending up to 1000 m above the lowest points in the central basin. The Columbia River enters near the northwest corner of the domain and is joined by the Yakima River near the southeast corner. A contour map of the central part of the region is included. In the summer of 1982, limited tracer measurements were made with an aircraft to study some of the circulation patterns that develop in this area. On several days, starting about an hour after sunrise, SF_6 was released for approximately 90 min at an elevation of 10 m AGL near the center of the basin.

15926 **(X-EP-LMD-RA—1985) Annual report of the Dynamic Meteorology Laboratory, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 801p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756703/JAW.

Research on climate simulation; data assimilation and forecasting; nonlinear dynamics and atmospheric turbulence; wave dynamics in the middle atmosphere; African and tropical meteorology and climatology; spectroscopy and modeling of atmospheric radiation; satellite meteorology and climatology; and active lidar remote sensing is presented.

15927 **(X-EP-LMD-RA—1986) Annual report of the Dynamic Meteorology Laboratory, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 89p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756704/JAW.

Research on climate simulation; data assimilation and forecasting; nonlinear dynamics and atmospheric turbulence; wave dynamics in the middle atmosphere; African and tropical meteorology and climatology; spectroscopy and modeling of atmospheric radiation; satellite meteorology and climatology; and active lidar remote sensing is presented.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 14224, 14225, 14232, 14234, 14235, 14236, 14237, 14238, 14257, 14281, 14489, 14490, 14649, 14650, 14651, 14893, 15009, 15971, 16146, 16152, 16153, 16157, 16159, 16160

15928 **(BNL—42203) 3CPO, Cloud Chemistry and Cloud Physics Organization: Data index, June 1988.** Tichler, J.; Norden, K.; Sharp, D. (Brookhaven National Lab., Upton, NY (USA)). Dec 1988. Contract AC02-76CH00016. 95p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007011/JAW.

This document is an index of the data that was collected as part of the Cloud Chemistry and Cloud Physics Organization (3CPO) cooperative convective storms program which took place in June 1988 in east central Illinois. The objective of 3CPO was to "assemble at a common time and location, the necessary measurement facilities to provide a previously unattained description of convective storm characteristics in polluted environments. 6 figs., 2 tabs.

15929 **(CIEMAT—619) Analysis of aliphatic and aromatic hydrocarbons in particulate matter in Madrid urban area.** Perez, M.; Mendez, J.; Bomboi, M.T. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 28p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756336/JAW.

Levels of n-alkanes and polycyclic aromatic hydrocarbons have been measured in the air particulate matter during six months, from January to June of 1987, in an urban area of Madrid. The hydrocarbons were collected on glass fiber filter by high volume sampling. The extraction was varried out by sohxlet and ultrasonic techniques. The extracts were clean-up on silica gel fractionation and the chromatographic analysis was performed by capillary coluymn gas chromatographic. Final results are discussed as well as the inmission values related to the possible emission sources.

15930 **(CIEMAT—620) High-resolution gas chromatographic analysis of polycyclic aromatic hydrocarbons and aliphatic hydrocarbons.** Perez, M. Gonzalez, D. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 31p. (In Spanish). NTIS (US Sales Only), PC A03. Order Number DE88756337/JAW.

A study of the analysis by gas chromatography of aromatic polycyclic hydrocarbons and alyphatic hydrocarbons is presented. The separation has been carried out by glass and fused silice capillary column in two different polar stationary phases OV-1 and SE-54. The limiation and the adventages of the procedure are discused in terms of separation, sensivity and precision.

15931 (CONF-8709398—, pp 11-27) **Wood burning furnaces tested for pollutant emissions.** Huisgen, M. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Lehrstuhl fuer Energie- und Kraftwerkstechnik). 1987. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770229/JAW.

From Meeting on wood waste heat supplies; Eschwege, F.R. Germany (22 Sep 1987).

Within the frame of a research program nine different 24 - 450 kW wood burning furnaces were tested for pollutant emissions. The tests performed served to determine flue gas temperatures and chemical compositions, solid particle emissions, the humidity of fuels, as well as wood chip consumption and calorific values. The data obtained allowed to determine the systems' energy efficiency and environmental effects.

15932 **(CONF-8811140—1) Implications of the greenhouse effect for the Midwest economy.** Streets, D.G.; Bloyd, C.N. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004195/JAW.

From 16. annual Illinois energy conference; Chicago, IL, USA (17 Nov 1988).

Although a great deal of research effort has been devoted to determining potential future changes in carbon dioxide concentrations, global temperature changes and ecosystem effects, relatively little attention has thus far been paid to potential regional impacts and the formulation of coherent policies to combat the problems. This paper will discuss how the Midwest might fare under conditions of higher mean temperatures or a major federal control program; it also discusses some of the research and development activities underway at Argonne National Laboratory that could help develop a balanced portfolio of technologies for combating the greenhouse effect. For the purposes of this paper we have defined a six-state region--consisting of the states of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin--to typify the Midwest. These are the same states that comprise Federal Region 5. Temperatures were averaged for the thirty-year period 1950--1980 and do not include some of the higher summer temperatures we have been experiencing in the 1980s. 15 refs., 8 figs., 3 tabs.

15933 **(DOE/ER/60655—1) Regional aerosol deposition in human upper airways: Progress report, June 1, 1988--February 28, 1989.** Swift, D.L. (Johns Hopkins Univ., Baltimore, MD (USA)). 1989. Contract FG02-88ER60655. 3p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007095/JAW.

The objective of this research program is to elucidate important factors which influence overall and local deposition of aerosols in the human airways above the trachea, including nasal airways, oral passage, pharynx and larynx. The intent is to develop information which can be used for exposure models for radon from unattached radon progeny ({approximately}1nm) up to 10 μm. Special emphasis is upon flow rate and airway dimensions as influenced by age and respiratory condition, as no experimental data presently exist for age-related deposition. Because of ethical and practical considerations associated with measuring aerosol deposition in chil-

dren and difficulties of measuring local deposition in vivo, our experimental approach is to construct faithful replicate models of the airways for several ages of humans in which detailed studies of deposition can be carried out with well-characterized aerosols. Initial studies of overall deposition of ultrafine aerosols in an adult model have been carried out using replicate nasal passage models provided from this laboratory. These studies demonstrate a significant deposition percent for particle sizes approaching that of unattached radon progeny (40--50%), decreasing as particle size approaches 0.1 μm. Studies of the effect of flow rate indicate that higher deposition percent is realized at lower flow rate over the range from 4--60 $lmin^{-1}$.

15934 **(EGG-M—88142) Challenge of assessing climate change effects on fish and wildlife resources in the western United States.** Breckenridge, R.P.; Otis, M.D.; Rope, R.C.; Cornish, J.G.; Trout, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 23p. (CONF-8807147—1). NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89005408/JAW.

From Annual meeting of the Western Association of Fish and Wildlife Agencies; Albuquerque, NM, USA (10 Jul 1988).

This paper presents a preliminary assessment of the sensitivity of western US fish and wildlife habitats and representative species to various scenarios of change. Output from global climate change models and professional judgement of environmental scientists and natural resource managers was used to provide an initial assessment. The basic premise of model calculations was a doubling of atmospheric CO_2 concentrations and the resulting greenhouse effect. A conceptual monitoring strategy is presented that provides guidance on identification and selection of sensitive indicators that could be integrated into a program that assesses the functional response of ecosystems to climate change. Ideas are presented on how to develop a monitoring program that has the potential of showing detectable response within practical limits of time and effort. The last section of this report addresses management options and policy issues that require attention when assessing climate change effects on F and W resources. Items discussed include how to manage and set policy regarding: habitat protection; rare, threatened, and endangered species; level of management; monitoring; and future land acquisitions. These will be challenging issues that will require policy and management attention to protect F and W resources for future enjoyment. 35 refs., 6 tabs.

15935 **(EPRI-EA—6164) Effects of sulfur dioxide and ozone on yield and quality of potatoes: Final report.** Pell, E.J.; Pearson, N.S.; Vinten-Johansen, C.; McGruer, G.; Yang, Y. (Electric Power Research Inst., Palo Alto, CA (USA); Pennsylvania State Univ., University Park (USA)). Jan 1989. 76p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006330/JAW.

The objectives of this project were to develop an outdoor fumigation facility designed to expose plants to ozone (O_3) and sulfur dioxide (SO_2) and to conduct experiments that would examine the impact of the two gases alone and in combination on field grown potato plants. Two systems of dispensing and monitoring pollutants were contrasted, one using miniature solenoid valves and the other using critical orifices. Both systems provided excellent pollutant control. The orifices were relatively inexpensive and required less maintenance than did the solenoid valve system. Two field experiments were conducted, one in 1985 and and the other in 1986. Potato plants were exposed to charcoal filtered air, nonfiltered air, nonfiltered air supplemented with O_3 at levels which resulted in 1.33, 1.66 or 1.99 times ambient O_3 concentrations or charcoal filtered air plus 0.14, 0.28 or 0.56 ppM SO_2. There were additional treatments combining the two pollutant regimes. Ozone induced a linear reduction in yield reflected by decreases in weight and number of tubers > 6.35 cm in diameter. In general effects on number and weight of smaller tubers were not detected. Ozone also induced a decrease in the percent dry matter and reducing sugar content of potato tubers. Sulfur dioxide affected number of Grade One tubers in both years and percent dry matter and sucrose content in 1986 only. While dose-response curves for all SO_2 effects fit quadratic curves the impact of SO_2 doses used in these experiments were stimulatory. No important interactions were observed between O_3 and SO_2. 36 refs., 5 figs., 31 tabs.

15936 **(EPRI-EA—6214) The Wisconsin regional Integrated Lake-Watershed Acidification Study (RILWAS): 1981--1983.** Knauer, D.; Brouwer, S.A. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA); Wisconsin Dept. of Natural Resources, Madison (USA)). Jan 1989. 312p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006849/JAW.

Round and East Eightmile lakes, small (14--15 ha) seepage lakes in thick (32--190 m) sandy outwash in northwestern Wisconsin, were studied from September 1981 through August 1983. Precipitation was 5 to 15 percent less than normal during the first year and 7 to 15 percent greater than normal during the second year. Snowfall accounted for 24 to 34 percent of the precipitation; however, all snowmelt infiltrated the highly permeable soils, and no spring depression in lake pH was observed. Chemistry of the precipitation was dominated by hydrogen ion, ammonium, and sulfate. Volume-weighted mean pH of bulk precipitation was 4.6 at both sites during the study, with hydrogen ion and ammonium contributing about 60 percent of the cations. Sulfate accounted for approximately 60 percent of the anions, annual sulfate fluxes ranged from 300 to 329 eq/ha. Dry deposition provided 7 to 36 percent of the total (wet plus dry) ion fluxes, except for magnesium (53 percent). Ion fluxes to the two lakes were similar. Volume-weighted mean lake pH's during the study were 6.4 at Round Lake and 6.9 at East Eightmile Lake. The two predominant forest canopies, mixed oak and jack pine, attenuated hydrogen ion; however, hydrogen-ion consumption by silicate hydrolysis exerted primary control on buffering capacity. Mineralogy of the very fine sand (100--50 μm) showed 46 to 55 percent weatherable minerals--orthoclase feldspar, plagioclase feldspar, mica, hornblende, olivine, and augite. Except for orthoclase, these minerals were depleted in the upper soil horizons, and all were undersaturated in soil solutions and ground water. The lakes contributed to the buffering capacity by producing alkalinity via surface reduction, primarily in epilimnetic lake sediment. 6 refs., 92 figs., 67 tabs.

15937 **(GAO/RCED—88-57) Air pollution.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 1988. 28p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

After 4 years of development and expenditures of $3 million, under a cooperative agreement with the Universities Research Group on Energy, the Environmental Protection Agency received an Advanced Utility Simulation Model for testing air quality that could not be used as an analytical tool because of major technical problems in several key components. EPA subsequently awarded a contract to Science Applications Internal Corporation to complete and test the AUSM. EPA estimates that development of the AUSM will be completed by the end of FY 1989 and that its total costs will be about $5.2 million.

15938 **(HWC—83-DHM-92) Feasibility of biological indicators as measures of community exposure air contaminants.** Sefton, M.V.; Phillips, M.J.; Jervis, R.E.; Gonzalez, L.A. (Health and Welfare Canada, Ottawa, Ontario). [1983]. 52p. (In French). (MICROLOG—83-4324). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report reviews the use of biological monitors (blood, urine, milk, adipose tissue, breath, saliva, nail clippings and hair) to follow the uptake by and incorporation in the body of organic pollutants, as reported in the literature from 1960 to the present. Use of non-human biological indicators (lichens, hair, feathers) is reviewed briefly. Trace elements and organic residues detected, the concentration levels at which they have been detected, and the analytical techniques employed are given for each matrix material. It is felt that the prospects for the use of biological monitors to assess community exposure to airborne contaminants are limited by: the virtual impossibility of distinguishing between absorption of the contaminant by inhalation, by ingestion, or through the skin; the very short biological half-life of many contaminants; and the difficulty of distinguishing the organic contaminant in the complex biochemical constitution of the matrices. 158 refs.

15939 (HWC—83-EHD-92) Feasibility of biological indicators as measures of community exposure air contaminants. Sefton, M.V.; Phillips, M.J.; Jervis, R.E.; Gonzalez, L.A. (Health and Welfare Canada, Ottawa, Ontario). [1983]. 37p. (MICROLOG—83-4323; CE—02128). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

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15940 (IVL-B—879) Sulfur dioxide, nitrogen oxide and soot in Swedish population centres. Grennfelt, P. (Swedish Environmental Research Inst., Goeteborg). 30 Nov 1987. 99p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756269/JAW.

SO/sub 2/, NO/sub 2/ and soot have been measured during six months in 1987 (winter season) at 39 different urban sites scattered all over Sweden. Each sample represents 24 hours mean value. The concentration ot SO/sub 2/ was mainly affected by two factors: the temperature and the long range transportation of air pollution. In the case of NO/sub 2/ the local sources, e.g. the traffic, was found more important.

15941 (PB—89-102503/XAB) Indoor air quality in public buildings. Volume 1. Final report. Sheldon, L.S.; Handy, R.W.; Hartwell, T.D.; Whitmore, R.W.; Zelon, H.S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1988. 535p. NTIS, PC A23/MF A01.

See also Volume 2, PB—89-102511. Portions of this document are not fully legible.

Indoor air quality was investigated in four buildings: a school, an office building, and two homes for the elderly. The main goals were to measure volatile organic compounds, inhalable particles, and air-exchange rates indoors and outdoors at each building; select one new building and make several monitoring visits over a six-month period to determine changes in indoor air quality as the building aged; and measure emission rates from building materials and cleaning operations in the new building. All buildings had higher levels of VOCs indoors than outdoors, with the new building having an indoor-outdoor ratio for all VOCs of about 50 (declining after two months to about 10, and after 5 months to about 5). Smoking lounges and apartments in the homes for the elderly had 24-hour average fine-particle concentrations of up to 100 micrograms/cu m compared to typical levels of about 10 micrograms/cu m. Cleaning operations emitted large quantities of halogenated VOCs, whereas paints, carpets, and adhesives emitted smaller quantities of aromatic and aliphatic compounds.

15942 (PB—89-102511/XAB) Indoor air quality in public buildings. Volume 2. Sheldon, L.; Zelon, H.; Sickles, J.; Eaton, C.; Hartwell, T. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1988. 733p. NTIS, PC A99/MF E04.

See also Volume 1, PB—89-102503. Portions of this document are not fully legible.

Two separate but closely related studies of exposures to volatile organic compounds (VOCs) in buildings where people spend long periods of time were conducted. This report summarizes results obtained in six buildings: a new hospital, office and nursing home and another office, office/school, and nursing home. At each building sampling was performed at three indoor locations and a single outdoor location.

15943 (PB—89-125462/XAB) Results of air samples at Fabco Industrial Insulation, Emeryville, California, September 1967. Lynch, J.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1968. 8p. (IWS—032.45A). NTIS, PC A02/MF A01.

Worker exposures to asbestos were surveyed in September 1967 at Fabco Industrial Insulation in Emeryville, California. Impinger samples contained 0.4 to 12.2 million particles per cubic foot (mppcf) and membrane filter samples contained 0.0 to 31.3 asbestos fibers greater than 5 microns per cubic centimeter (f/cc). Several samples from the mixing, finishing, packing, and hopper rooms contained asbestos concentrations in excess of the 1967 threshold limit value of 5 mppcf as measured by impinger sampling or 12.O f/cc as measured by the membrane filter method.

15944 (PB—89-128268/XAB) Nitrous oxide problem. de Soete, C.G. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Thermal Engineering). 1988. 83p. NTIS, PC E04/MF A01.

The content of this report includes the following three parts: Part one, Nitrous oxide: Why is it a pollutant; Part two, N_2O formation/destruction mechanisms in combustion; Part three, Problems related to N_2O sampling in flue gases.

15945 (PB—89-128631/XAB) Compilation of air-pollutant emission factors. Volume 1. Stationary point and area sources, Fourth Edition. Supplement B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1988. 173p. (AP—42-SUPPL-B). NTIS, PC A08/MF A01.

See also PB—86-124906.

In the supplement to the Fourth Edition of AP-42, new or revised emissions data are presented for Bituminous And Subbituminous Coal Combustion; Anthracite Coal Combustion; Residential Wood Stoves; Waste Oil Combustion; Refuse Combustion; Sewage Sludge Incineration; Surface Coating; Polyester Resin Plastics Product Fabrication; Soap and Detergents; Grain Elevators and Processing Plants; Lime Manufacturing; Crushed Stone Processing; Western Surface Coal Mining; Wildfires and Prescribed Burning; Unpaved Roads; Aggregate Handling And Storage Piles; Industrial Paved Roads; Industrial Wind Erosion; and Appendix C.3, Silt Analysis Procedures.

15946 (PB—89-129019/XAB) Estimating air-toxics emissions from organic-liquid storage tanks. Final report. Murphy, P. (Midwest Research Inst., Cary, NC (USA)). Oct 1988. 121p. NTIS, PC A06/MF A01.

To assist groups interested in inventorying air emissions of potentially toxic substances, EPA is preparing a series of documents that compiles available information on sources and emissions of toxic substances. The document deals specifically with methods to estimate air toxics emissions from organic-liquid storage tanks. Its intended audience includes Federal, State, and local air pollution personnel and others interested in making estimates of toxic air pollutants emitted from organic-liquid storage tanks. The document presents equations for estimating air-toxics emissions from organic liquid-storage tanks and demonstrates through examples how to use the equations. Information is also provided on storage tanks typically associated with source categories.

15947 (PB—89-129027/XAB) Multiple Air-Toxics Exposure Study Working Paper Number 3. Urban air-toxics exposure model: development and application. (South Coast Air Quality Management District, El Monte, CA (USA)). Nov 1988. 127p. NTIS, PC A07/MF A01.

The South Coast Air Quality Management District of California completed a Multiple Air Toxics Exposure Study (MATES) that examines the additive risk from a number of air toxics on an urban area. The project, though partially funded by EPA, is an example of how a State or local agency may approach assessing their local air-toxics risks as is encouraged by EPA's Urban Air Toxics Program which results from EPA's Air Toxic Strategy. The report is a summary of the methods used by the California agency. Though not intended as an endorsement of the entire contents of the report, EPA is reproducing their report (Working Paper

Number 3) to benefit and encourage other agencies that may be contemplating such an assessment.

15948 **(PB—89-129159/XAB) Area-source estimates for the 1985 NAPAP (National Acid Pprecipitation Assessment Program) Emissions Inventory.** Demmy, J.L.; Mann, C.O.; Pahl, D.A. (Alliance Technologies Corp., Chapel Hill, NC (USA)). Nov 1988. 19p. NTIS, PC A03/MF A01.

This paper discusses the revised area-source methodologies used by the National Acid Precipitation Assessment Program (NAPAP) and EPA's Office of Air Quality Planning and Standards (OAQPS) to generate the emissions estimates found in the 1985 NAPAP Emissions Inventory. The information may be useful to inventory participants, users, and those affected by regulations that may have resulted from information contained in the inventory. It includes an overview of estimation procedures for stationary, mobile, and miscellaneous area-source categories. In addition, a more-detailed description of the estimation procedures, including general assumptions and references used to obtain input data, is presented for new and revised area sources.

15949 **(PB—89-129407/XAB) Economic analysis of treatment technologies to achieve VOC (volatile organic chemicals) removal to safe levels.** Clark, R.M.; Adams, J.Q. (Environmental Protection Agency, Cincinnati, OH (USA). Drinking Water Research Div.). Nov 1988. 58p. (EPA—600/D-88/245). NTIS, PC A04/MF A01.

In the VOC regulations both Granular Activated Carbon (GAC) and Packed Tower Aeration (PTA) have been designated as Best Available Treatment. DWRD has performed a great deal of research both at the bench, pilot, and field scale on the use of GAC and pilot and field-scale research for PTA. Cost and performance data were collected for both technologies. This paper compares predictions of cost and performance of GAC and PTA using available models and field-scale data. A sensitivity analysis of each technology with respect to design and operating variables and cost is made. Liquid-phase GAC and PTA with off gas control is compared. Each technology is described, cost and performance will be discussed, and comparative evaluations is made.

15950 **(PB—89-129456/XAB) Integrated approach to the characterization of particle and organic emissions from unvented kerosene space heaters.** White, J.B.; Leaderer, B.P.; Boone, P.M. (John B. Pierce Foundation of Connecticut, Inc., New Haven (USA)). Nov 1988. 12p. NTIS, PC A03/MF A01.

The paper reports the results from a three-phase study characterizing and modeling particle and organic emissions from unvented kerosene space heaters, a major source of indoor air contaminants. In Phase I, emissions from 12 heaters covering a range of design types and Btu ratings, were evaluated. Aerosol mass, size distribution, extractable mass, bioassay, and trace element content, as well as conventional gas (CO, NOx, etc.) measurements were made for all the heaters tested, while VOCs and semivolatiles measurements were made for a subsample of the heaters. In Phase II, a detailed characterization of particle and organic emissions for four heaters was performed. Two of the heaters subjected to the detailed chamber testing in Phase II were then used in Phase III, which consisted of a series of heater runs in the EPA test house in North Carolina. The test house experiments were designed to validate model predictions based on the chamber studies in Phase II.

15951 **(PB—89-129464/XAB) Incinerator ash quality, residue characteristics, and control of heavy-metal emissions.** Carroll, G.J. (Environmental Protection Agency, Cincinnati, OH (USA). Risk Reduction Engineering Lab.). Nov 1988. 23p. (EPA—600/D-88/252). NTIS, PC A03/MF A01.

Limited information from past research indicates that organic concentrations in hazardous-waste incinerator (HWI) ash and air-pollution-control device residue are low, and that destruction is the primary reason for high Destruction and Removal Efficiency (DRE) values. Increasing attention is being focused on HWI stack metal emissions, which appear to be the most significant component of HWI risk-assessment values derived to date.

15952 **(PB—89-129589/XAB) Measurement of worker's exposure to styrene. Final report.** Cohen, B.S.; Malek, R. (New York Univ., NY (USA). Inst. of Environmental Medicine). 3 Aug 1988. 23p. NTIS, PC A03/MF A01.

Studies were conducted to determine the effectiveness of personal samplers in the work place by documenting the magnitude of the variability in breathing-zone concentrations of styrene within the reinforced-plastics industry, determining factors that contribute to breathing-zone concentrations, and investigating the stability of styrene samples taken with charcoal tubes. Measurements were taken at a facility for manufacturing boats where the production process included spraying a catalyzed resin solution along with chopped fiberglass onto a mold. The average background air concentration was $18mg/m^3$. The personal exposure concentrations were: nose, $327mg/m^3$; left lapel, $365mg/m^3$; right lapel, $388mg/m^3$; and chest, $430mg/m^3$. Factors affecting the concentration in the breathing zone included air-flow patterns, the hood face velocity, and the position of the worker relative to the hood and relative to the spray gun. Styrene, being a volatile and reactive compound, may undergo physical and chemical changes such as vaporization, oxidation and polymerization, any of which would cause underestimation if they occurred following the sample collection. Samples collected on charcoal were stable up to 4 weeks in storage.

15953 **(PB—89-129662/XAB) Preliminary control technology assessment of the Belden Brick Company, Sugarcreek, Ohio, January 19, 1982.** Mahon, R.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). Mar 1982. 13p. (ECTB—110-15A). NTIS, PC A03/MF A01.

An on-site visit was made to Belden Brick Company, Sugarcreek, Ohio to evaluate control methods used at this facility to protect workers from hazardous conditions on the job. The company used a variety of clays and shales from on-site mines plus color additives in the manufacture of ceramic brick. The raw materials were crushed, blended, formed, dried, fired, drawn, packaged, and shipped or placed in storage. The potential existed for exposures to silica, extremes of temperature, noise, and color additives. About 250 million standard bricks were made each year. The engineering controls appeared to be effective and efficient, consisting of exhaust ventilation, operation enclosures, scrap handling, noise attenuation, and vibration dampening. Some use of monitoring systems was noted. According to the author, these systems would be worth an in-depth evaluation. It would also be useful to evaluate their use of personal protective equipment. The in-depth study should be scheduled when the controls are in a full-production mode.

15954 **(PB—89-129753/XAB) Preliminary control technology assessment of Mansfield Sanitary, Incorporated, Errysville, Ohio.** Cooper, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1982. 10p. (ECTB—110-16A). NTIS, PC A02/MF A01.

A visit was made to the Mansfield Sanitary Facility, Perrysville, Ohio to evaluate control methods in place at the site to protect workers from on the job hazards. This facility used a variety of clays, parting compounds, and color additives to blend, form, dry, fire, package, and ship as ceramic plumbing products. Clays used include feldspar, pearless china clay, and nepheline syenite from various suppliers. Other raw materials included Millwood sand, gum, cultozine-fuchsine, industrial plaster, stain, glaze, magnesium aluminum silicate, talc, feldspar, and zirconium silicate. The company made good use of several ventilation techniques at loading stations, transfer points, automatic assembly lines, and the glazing stations. Parting dust became airborne when applied to the molds and while the mold was being dried. Exhaust-ventilation booths used for the spraying of glaze appeared to be very effective. Several areas in which dust-control methods appeared inadequate were noted. The author recommends that some of the work practices and personal protective equipment used as controls should be examined in an in-depth evaluation and documentation.

15955 **(PB—89-129795/XAB) Walk-through survey report: perchloroethylene, Roycourt Cleaners, Detroit, Michigan.** Roberts, D.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 8 Jan 1980. 14p. (IWS—71.32.10). NTIS, PC A03/MF A01.

See also PB—82-209560.

A walk-through survey was conducted at the Roycourt Cleaners, Detroit, Michigan to assess the exposure of workers at the facility to perchloroethylene (PCE). Battery operated pumps and charcoal tubes were used to collect the air samples. PCE has been used by the company in dry cleaning since 1971. About 76 liters of PCE are used each month and about 270 kilograms of clothing are cleaned each week. The company followed a routine maintenance program check twice a month at which time the gaskets and seals were inspected for leaks. Exposures in the dry cleaning area ranged from 0.4 to 11.0 parts per million (ppm) with peak exposures to the dry-cleaner ranging from 8.1 to 13ppm. Exposures were within the currently acceptable range. The author suggests that preplacement physical examinations be provided for workers, that engineering controls such as exhaust ventilation be installed, that respiratory protection be provided for use during emergencies such as spill cleanup, that protective clothing be used to prevent skin contact, that all employees be informed of the hazards of the job, and that storage containers, equipment, piping, and valves be checked periodically.

15956 **(PB—89-129803/XAB) Preliminary survey report, Didier Taylor Refractories Corporation Plant, Newtown, Ohio.** Mahon, R.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 20 Oct 1981. 5p. (ECTB—110-12A). NTIS, PC A02/MF A01.

See also PB—84-242114.

An on-site visit was made to the Didier Taylor Refractories Corporation located in Newtown, Ohio for the purpose of evaluating control methods instituted to protect workers from hazardous conditions. Raw materials were received at this location in bags and canisters. The bags were opened in an area with dual-pull exhaust ventilation from two sides. Several St. Regis single spout packers with local exhaust systems were also used at this facility. All exhaust ducts connected to a large Kirk and Blum dry-bag collector located adjacent to the building. Some molding and casting work was done at this facility, but no particularly significant health hazard controls were noted for the process. The product line included bricks, patches, ramming mixes, cements, castables, plastics, and miscellaneous items. Plaster of paris and thermo setting plastics were used as mold materials. Slip mixes involved a wide range of chemical compounds. Plans were made to conduct a walk-through preliminary-type survey of the location at a later date. An in-depth assessment of portions of the facility and operations may be decided upon at that time.

15957 **(PB—89-129811/XAB) Preliminary control technology assessment of American Olean Tile Company, Lewisport and Cloverport, Kentucky.** Godbey, F.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). Jan 1983. 10p. (ECTB—110-24A). NTIS, PC A02/MF A01.

See also PB—86-225232.

The control methods employed at the American Olean Tile Company, in Lewisport and Cloverport, Kentucky during the production of quarry clay tile were examined. Potential exposures included silica, color additives, temperature extremes, and noise. Ball clays and shale were dumped in raw material storage bins. Materials were fed from the hoppers onto conveyors and transported for grinding. The ground material was discharged onto a conveyor for transport to vibrating screens; properly sized particles passed through to another conveyor. Other materials were added from the hoppers onto the conveyor for blending. Blended materials were transported by conveyor to storage hoppers in the mill area. The material was mixed with water, blended, deaerated and extruded in a continuous ribbon which was automatically cut into tiles and placed onto trays in a batch-type dryer. Tiles were then fired and finished for shipping. Annual silica sampling was carried out in the crushing area. Annual physical examinations were provided for employees exposed to silica. Protective equipment included respirators, hard hats, dust masks and safety glasses. Local-exhaust ventilation systems in the clay preparation and grinding areas were effective in protecting workers. The author recommends that the company be included in an in-depth study of ventilation systems to control dusts in clay preparation and grinding areas.

15958 **(PB—89-129829/XAB) Preliminary control technology assessment of Cominco American, Inc., Bixby, Missouri.** Godbey, F.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 3 Aug 1981. 12p. (ECTB—111-12A). NTIS, PC A03/MF A01.

See also PB—86-225364.

A visit was made to Cominco American, Inc., Bixby, Mssouri to investigate their means of controlling possible hazardous working conditions for their employees involved in the beneficiation of lead ore. Approximately 4600 tons of ore were processed each day at the mill to produce lead, copper and zinc concentrates. Several of the control measures in place at the facility were state of the art including the use of isolated control booths for crushing, grinding, and flotation; good housekeeping program with a removal of dust on roadways and dock areas; use of binders sprayed over the lead concentrate pile stored in the open to prevent air erosion and contamination and oxidation of the lead sulfide; use of a binder, vinyl latex emulsion, to cover zinc concentrate shipped on gondola car; use of a water spike to empty drums of cyanide and xanthate, and the lining of the truck bed hauling lead concentrates and other areas; use of an aspirator-type vacuum system in the reagent room for dumping bags of starch to reduce dust; the use of wall insulation for temperature and noise control; and the use of an enclosed conveyor system. The author recommends that this facility be made a part of the in-depth study of health hazards at lead-ore-beneficiation facilities so that a more-detailed evaluation of the effectiveness of these control measures may be undertaken.

15959 **(PB—89-129837/XAB) Preliminary control technology assessment of Amax Lead Company of Missouri, Buick, Missouri.** Godbey, F.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 6 Aug 1981. 18p. (ECTB—111-13A). NTIS, PC A03/MF A01.

See also PB—86-224409.

A visit was made to the Amax Lead Company, Buick, Missouri to evaluate control methods in use. The company was engaged in the beneficiation of lead ore, processing 7500 tons per day of a complex sulfide ore containing about 9% lead. The Amax Buick facility was involved in crushing and screening, grinding and classification, lead and zinc selective flotation, thickening, and dewatering. The system consisted of two cone crushers with related screens operating in closed circuit with the necessary conveyor belts to handle the ore. A good-housekeeping program was in effect, with efforts to remove residual dust from floors by wet sweeping and washing down as needed. All crushing and screening operations were regulated from a control room located in the crushing facility which included a motor control panel, annunciator system, and indicators for major-equipment operation. Crushed ore was weighed by a Ramsey conveyor scale. Ore levels in the two fine ore bins were measured by Milltronics ultrasonic level devices. The grinding circuit was an automated operation in which the primary control objectives were to effectively control the particle size of the cyclone overflow product and maintain an optimum circulating load. The author recommends the establishment for inclusion in an in-depth study.

15960 **(PB—89-129845/XAB) Walk-through survey of E. Ii. du Pont de Nemours and Company, Inc., Louisville, Kentucky.** Jones, J.H.; Young, R.J.; Selevan, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Field Studies and Clinical Investigations). Dec 1975. 10p. (IWS—87.10). NTIS, PC A02/MF A01.

A walk-through survey was conducted at the E.I. du Pont de Nemours and Company, Inc., Louisville, Kentucky to observe the manufacture of neoprene and discuss environmental-monitoring programs for the safety of employees. Unrefined, refrigerated chloroprene monomer was brought to the facility where it was distilled as needed. Chloroprene monomer, resin, and modifier were mixed and added with a water solution in a large glass-lined reactor vessel

for polymerization producing either full conversion latex or a solid material. The company provided complete preemployment physicals, and one every 3 years for employees less than 40 years old and once every 1.5 years for those over 40. Three cases of asbestosis were reported in pipe-insulation workers. Some cases of skin cancer were documented and hair loss due to chloroprene exposure was also noted. A chloroprene monitoring program was begun in the early 1970s; corrective actions were taken to lower chloroprene concentrations. Asbestos was no longer used on process piping but potential exposure still exists. Acrylonitrile was used as a copolymer in chloroprene production. Exposure to talc was also possible. Freon-22 was manufactured at this location. The authors recommend that exposure to chloroprene be kept as low as possible.

15961 **(PNL—6799) Evaluate and characterize mechanisms controlling transport, fate and effects of army smokes in an aerosol wind tunnel: Transport, transformations, fate and terrestrial ecological effects of fog oil obscurant smokes: Final report.** Cataldo, D.A.; Van Voris, P.; Ligotke, M.W.; Fellows, R.J.; McVeety, B.D.; Li, Shu-mei W.; Bolton, H. Jr.; Fredrickson, J.K. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 106p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006573/JAW.

The terrestrial transport, chemical fate, and ecological effects of fog oil (FO) smoke obscurants were evaluated under controlled wind tunnel conditions. The primary objectives of this research program are to characterize and assess the impacts of smoke and obscurants on: (1) natural vegetation characteristic of US Army training sites in the United States; (2) physical and chemical properties of soils representative of these training sites; and (3) soil microbiological and invertebrate communities. Impacts and dose/responses were evaluated based on an exposure scenario, including exposure duration, exposure rate, and sequential cumulative dosing. Key to understanding the environmental impacts of fog oil smoke/obscurants is establishing the importance of environmental parameters, such as relative humidity and wind speed on airborne aerosol characteristics and deposition to receptor surfaces. Direct and indirect biotic effects were evaluated using five plant species and three soil types. 29 refs., 35 figs., 32 tabs.

15962 **(PNL-SA—16339) The causes and consequences of global climate change.** Hinds, W.T. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 24p. (CONF-8811143—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004355/JAW.

From United States Department of Agriculture (USDA) national agriculture research and extension user's advisory board meeting; Lafayette, IN, USA (9 Nov 1988).

The intent of this paper is to outline the science underlying our understanding of the causes and consequences of global warming research, including: how a global warming might be induced; how sure we can be about both causes and consequences; and what research is currently underway.

15963 **(UCRL—21062) Health risk assessment of trans-1,2-dichloroethylene in California drinking water.** Hall, L.C.; Mallon, B.; Hsieh, P.; McKone, T.E. (Lawrence Livermore National Lab., CA (USA)). 24 Jan 1989. Contract W-7405-ENG-48. 74p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007229/JAW.

This document presents an assessment of the potential health risks associated with exposure to trans-1,2-dichloroethylene (trans-1,2-DCE) dissolved in California drinking waters. This assessment is being provided to the California Department of Health Services (CDHS) for the development of drinking-water standards to manage the health risks of trans-1,2-DCE exposure. Other assessments required in the risk-assessment process include analyses of the technical and economic feasibilities of treating water supplies contaminated with trans-1,2-DCE. A primary goal of this health-risk assessment is to evaluate dose-response relationships for observed and potential toxic end points of trans-1,2-DCE in order to define dose rates that can be used to establish standards that will protect members of the general public from adverse health effects resulting solely from water-based exposures to trans-1,2-DCE. We also analyze the extent of human exposures attributable to trans-1,2-DCE-contaminated groundwater in California. The document consists of seven sections, plus an appendix. Our assessment begins in Section 2 with a review of the uses of trans-1,2-DCE, its environmental chemistry, and concentrations measured in different environmental media. The next section provides an overview of published studies on the absorption and metabolism of trans-1,2-DCE. In Section 4, we review studies of the acute and subchronic toxicity of trans-1,2-DCE to animals and humans.

15964 **(UCRL—100144) Scenarios for future climate change: Results of GCM [General Circulation Model] simulations.** MacCracken, M.C. (Lawrence Livermore National Lab., CA (USA)). 27 Sep 1988. Contract W-7405-ENG-48. 10p. (CONF-8809282—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006151/JAW.

From First United States-Canada symposium on the impact of climate change on the Great Lakes basin; Chicago, IL, USA (27 Sep 1988).

The continuing emissions of gases that are able to increase the efficiency with which the atmosphere traps infrared radiation are beginning to alter the global climate. During the next century, theoretical simulations project that global average temperatures will rise by several degrees Celsius above their pre-industrial baseline and that precipitation patterns may shift seasonally and spatially. Although research is being intensified so that detailed regional estimates can be provided, projected increases in summer temperatures and the accompanying increased evaporation, especially during natural warm excursions such as the summer of 1988, appear to pose troubling conditions for water supplies, agriculture, transport, and other activities dependent on water resources. 9 refs.

15965 **(VTT-TIED—887) Emission measurement of energy production.** Vesterinen, R. (Valtion Teknillinen Tutkimuskeskus, Jyvaeskylae (Finland). Kotimaisten Polttoaineiden Lab.). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1988. 133p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756313/JAW.

The present study gives an account of the sampling and measurement techniques of the emissions generated by energy production in different countries. Two different techniques, using two different methods of particle separation, are presently employed in the measurement of particle emissions. In one method the particles are separated from flue gas in the filter holder and/or the cyclone inside the stack. In other method the particles are separated in the filter and/or cyclone which is outside the stack. The size distribution measurement of the particles can be performed simultaneously with particle concentration measurement by using cascade centripeters or cyclones. The filter sample that is collected in this way may also be used to determine heavy metals. The determination of sulphur and nitrogen oxides is conducted both by single sampling or continuous sampling techniques. UV- and IR-absorption based techniques, as well as electrochemical sensors are used to measure these oxides. The flurescence method is also in general use in the measurement of sulphur dioxides. Emissions from nitrogen are generally measured by using the chemiluminescence method. Sampling is done either by separating the particles and the water from the gas sample and conducting the dry gas to the analyzer, or by using a diluting technique, where the gas sample is diluted with air and conducted without condensation to the analyzer. One common feature of methods for the measurement of organic compounds is that the particles and the water are separated from the flue gas. At the final stage the compounds to be analyzed are collected in the absorption solution and/or in some adsorption material. All part samples, ie. particles, condensate, absorbent and adsorption material, are often separately analyzed. The analysis is carried out to an increasing degree with the gas chromatograph mass spectrometer.

15966 **Acid deposition and forest nutrient cycling.** Johnson, D.W. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Energy technology XIV. Rockville, MD; Government Institutes Inc. (1987). (CONF-870416—).

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

Early conceptualizations of forest nutrient cycles depicted atmospheric deposition as an input to the system and, by implication, considered it to be beneficial (Cole et al, 1968; Curlin and Nelson, 1970; Duvigneaud and Denyear-DeSmet, 1970). These early studies took an ecosystem perspective, and detailed process-level research was left for the future. With the discovery of acid deposition in the late 1960s, atmospheric deposition has began to be viewed as a cause of nutrient loss rather than gain. In order to understand the effects of atmospheric deposition upon nutrient gains and losses, acid deposition researchers concentrated upon important nutrient transfer processes (primarily foliar and soil leaching, but also including decomposition), but have not until recently placed this process-level research into an ecosystem-level, nutrient cycling perspective. A great volume of literature now exists on the effects of acid deposition upon nutrient cycling processes in forest ecosystems, including several books and review articles (e.g., Hutchinson and Hayes, 1980; Drablos and Tollan, 1980; Johnson et al., 1982; Ulrich and Pankrath, 1983; Rehfuess, 1987). This paper briefly reviews some of the highlights in the rapidly expanding literature on this subject.

15967 **PAH-contaminated materials management at Oak Ridge National Laboratory.** Braunstein, H.M.; Eisenhower, B.M.; Dreibelbis, W.G. (Dept. of Environmental Management, Industrial Safety and Applied Health Physics Div., Oak Ridge National Lab., Oak Ridge, TN 37830 (US)). pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

Research at a large experimental facility such as the Oak Ridge National Laboratory (ORNL) involves a very wide assortment of technological, health, environmental, and analytical studies, many of which have the potential for generating hazardous materials. For example, studies involving the conversion of coal into usable, substitute energy products produce gas, liquid, and solid streams, many of which contain coal-derived organic compounds capable of causing adverse environmental and health effects. Because experiments are unlike one another and because each experiment involves varying conditions, the materials being handled and requiring disposal are unpredictable in amounts, frequency of generation, and composition. Thus, in structuring programs such as the coal technology program such as the coal technology programs at Oak Ridge National Laboratory, activities such as personnel monitoring and management of waste streams are built into the research planning and activities. PAH-contaminated materials management at ORNL utilizes a variety of techniques, both administrative and technical, to simplify situational problems, to satisfy regulatory, cost, and operational constraints, and to accommodate the researcher. The Laboratory's experience with hazardous materials handling and monitoring, although not entirely problem-free, should be a valuable addition to other workplace experiences.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 14760, 14831, 14832, 15601, 15928, 15996, 16080, 16131, 16136, 16137, 16143

15968 (IA—1440, pp 265-266) **Measurements of the effectiveness of air-cleaner/ionizers in reducing the radon progeny concentration of indoor air.** Tal, A.; Even, O.; Shamai, Y.; Israeli, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

15969 **(INPE—4486) Radon-222 in the antartic peninsula.** Pereira, E.B.; Setzer, A.W.; Cavalcanti, I.F.A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Mar 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705537/JAW.

We present the experimental data of continous measurements of Radon-222 at the Brazilian Antartic Station (62/sup 0/S, 58/sup 0/W) during the year of 1986. (M.W.O.).

15970 **(NEI-SE—30) Project Radon. Progress report January 1988, Programs for 1988 and 1989.** Ekholm, S. (Swedish State Power Board, Vaellingby). 29 Apr 1988. 33p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756201/JAW.

The project started in March 1987. The objective is to perform radon monitoring in 2000 dwellings occupied by people employed by State Power Board and to continue to contribute to the development of radon filters. The project participates in developing methods for radon measurement and decontamination and in adapting the methods to large scale application. About 400 so called radon trace measurements (coarse measurement) and about 10 action measurements (decontamination measurement) have been made so far. Experience shows that methods are fully applicable and that the decontamination measures recommended give perfectly satisfactory results. It is also established that most of the houses with high radon levels have poor ventilation Many of them suffer from moisture and mould problems. The work planned for 1988 and 1989 will in addition to measurements be directed towards improvement of the measuring methods. An activity catalogue will be prepared in cooperation with ventilation enterprises. (O.S.).

15971 **(PNL—6816) Environmental monitoring master sampling schedule: January--December 1989.** Bisping, L.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 49p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007101/JAW.

Environmental monitoring of the Hanford Site is conducted by the Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE). This document contains the planned schedule for routine sample collection for calendar year 1989 for the Surface and Ground-Water Environmental Monitoring Projects. This schedule is subject to modification during the year in response to changes in Site operations, program requirements, and the nature of the observed results. Operational limitations such as weather, mechanical failures, sample availability, etc., may also require schedule modifications. Changes will be documented in the respective project files, but this plan will not be reissued. This schedule includes routine ground-water sampling performed by PNL for Westinghouse Hanford Company, but does not include samples that may be collected in 1989 to support special studies or special contractor projects, or for quality control. The sampling schedule for Site-wide chemical monitoring is not included here, because it varies each quarter as needed, based on past results and operating needs. This schedule does not include Resource Conservation and Recovery Act ground-water sampling performed by PNL for Hanford Site contractors, nor does it include sampling that may be done by other DOE Hanford contractors.

15972 **(SCPRI-RM—7-1988) Monthly results of measurements, July 1988.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Aug 1988. 41p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756688/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

15973 **(SCPRI-RM—8-1988) Monthly results of measurements, August 1988.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Sep 1988. 43p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756689/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented

in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 14281, 15928

5005 Site Resource And Use Studies

15974 **Anarctic gridded sea level pressure data: An analysis and reconstruction back to 1957.** Jones, P.D.; Wigley, T.M.L. (Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom). *Journal of Climate;* 1: No. 12, 1199-1220(Dec 1988).

The reliability of the Australian (June 1972--April 1985) and NOTOS (1957--62) gridded monthly-mean, mean sea level pressure datasets over Antarctica is examined by comparison with station data from 29 sites over the continent. After rejecting about 30% of the months in both sets of gridded data, the remaining "good" months are used in a principal component regression technique to reconstruct gridded data from the station data for 1957 to 1985. The regression technique uses the "good" Australian data for calibration and verifies the statistical relationships developed between station and grid point pressure data with the "good" NOTOS data. The reconstructions are shown to be reliable over all of Antarctica between 60° and 75 °S except in the area to the east of the Ross Sea and adjacent areas of the southern Pacific Ocean.

5006 Regulations

REFER ALSO TO CITATION(S) 14618

15975 **(PB—89-127526/XAB) Meteorological Processor for Regulatory Models (MPRM-1.1) user's guide.** Irwin, J.S.; Paumier, J.O.; Brode, R.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jul 1988. 225p. (EPA—600/3-88/043). NTIS, PC A10/MF A01.

Version 1.1 of Meteorological Processor for Regulatory Models (MPRM) provides a general-purpose computer processor for organizing available meteorological data into a format suitable for use by air-quality dispersion models. Specifically, the processor is designed to accommodate those dispersion models that have gained EPA approval for use in regulatory decision making. MPRM can be envisioned as a three-stage system. The first stage retrieves the meteorological data from computer tape or disk files and processes the data through various quality-assessment checks. The second stage collects all data available for a 24-hour period (upper air observations, hourly surface weather observations, and data collected as part of an on-site meteorological measurement program) and stores these data in a combined (merged) format. The third stage reads the merged meteorological data and performs the necessary processing to produce a meteorological data file suitable for use by the specified dispersion model.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 15099, 15100

15976 **(INPE—4376) Radiometric characterization of six soils in the microwave X-range through complex permittivity measurements.** Palme, U.W. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Oct 1987. 266p. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS. Order Number DE88705533/JAW.

Estimating and monitoring up-to-date soil moisture conditions over extensive areas through passive (or active) microwave remote sensing techniques requires the knowledge of the complex relative permittivity (ϵ/sub r//sup */) in function of soil moisture. X-band measurements of ϵ/sub r//sup */ for different moisture conditions were made in laboratory for soil samples of six important Soils (PV/sub 2/, LV/sub 3/, LR/sub d/, LE/sub 1/, SAP and Sc). Using a theoretical model and computational programmes developed, these measurements allowed estimates of the emissive characteristics of the soils that would be expected with the X-Band Microwave Radiometer built at INPE. The results, new, for soils from tropical regions, showed that only the physical characteristics and properties of the soils are not sufficient to explain the behaviour of ϵ/sub r//sup */ in function of soil moisture, indicating that the chemical and/or mineralogical properties of the soils do have an important contribution. The results also showed thast ϵ/sub r// sup */ in function of soil moisture depends on soil class.

5101 Basic Studies

REFER ALSO TO CITATION(S) 14969, 15507, 15980, 15981, 15982, 15983, 15984, 15985, 15986, 15987, 15988, 15989, 15990, 15991, 15992

15977 **(CIEMAT—622) Determination of thorium 230 in soils.** Alvarez, A.; Palomares, J. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 21p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756339/JAW.

A method for the determination of Th-230 in environmental soils is described. Hydroxides are formed, previous fusion with sodium peroxide, are disolved with HNO_3 8N. Then thorium is coprecipitated with F_3La and purified by anion exchange (AG 1X8 50-100 mesh). Thorium is electroplated onto a stanless steel disc, Th-230 is counted by alpha spectrometry and Th-234 used as tracer by beta counting. The chemical yield for 1g of soil sample is 60-80%. Minimum detectable activities are about 2 mBg/g.

15978 **(LUTKDH/TKKT—1003-1-180-1988) Modeling acidification mitigation in watersheds.** Warfvinge, P. (Lund Inst. of Tech. (Sweden). Dept. of Chemical Engineering). 10 May 1988. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756275/JAW.

Modeling of acidification mitigation processes in watersheds allows different neutralization methods to be compared regarding system chemical response and economics. A model for calcite dissolution under lake liming conditions is described, and verified under controlled conditions. Applying a mass balance approach, a reacidification model for limed lakes was developed, and the capabilities demonstrated for a number of lakes. Based on mechanistic sub-models for limestone dissolution in soils, cation exchange reactions, soil solution buffering and leaching and accumulation in soil horizons, a model to describe the process of soil neutalization following addition of limestone to the soil, was developed. The model shows that the rate of dissolution of limestone in soils depends on the rate of cation exchange reactions, as well as the limestone dissolution kinetics. An economic evaluation indicated that direct water body neutralization is more cost-efficient than terrestrial liming in watersheds. The weathering rates in acidified catchments was assessed, and the results incorporated in a steady-state model to calculate the equilibrium states of soil profiles. The model shows that the silicate mineral composition, rate of acid deposition and net biomass removal rate are key parameters in determining a soil's resistance to acidification. (With 41 refs.)

15979 **(PNL—6485-Rev.1) Ecological baseline study of the Yakima Firing Center proposed land acquisition: A status report.** Rogers, L.E.; Beedlow, P.A.; Eberhardt, L.E.; Dauble, D.D.; Fitzner, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 74p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006565/JAW.

This report provides baseline environmental information for the property identified for possible expansion of the Yakima Firing Center. Results from this work provide general descriptions of the animals and major plant communities present. A vegetation map derived from a combination of on-site surveillance and remotely sensed imagery is provided as part of this report. Twenty-seven wildlife species of special interest (protected, sensitive, furbearer, game animal, etc.), and waterfowl, were observed on the proposed expansion area. Bird censuses revealed 13 raptorial species (including four of special interest: bald eagle, golden eagle, osprey, and prairie falcon); five upland game bird species (sage grouse, Califor-

nia quail, chukar, gray partridge, and ring-necked pheasant); common loons (a species proposed for state listing as threatened); and five other species of special interest (sage thrasher, loggerhead shrike, mourning dove, sage sparrow, and long-billed curlew). Estimates of waterfowl abundance are included for the Priest Rapids Pool of the Columbia River. Six small mammal species were captured during this study; one, the sagebrush vole, is a species of special interest. Two large animal species, mule deer and elk, were noted on the site. Five species of furbearing animals were observed (coyote, beaver, raccoon, mink, and striped skunk). Four species of reptiles and one amphibian were noted. Fisheries surveys were conducted to document the presence of gamefish, and sensitive-classified fish and aquatic invertebrates. Rainbow trout were the only fish collected within the boundaries of the proposed northern expansion area. 22 refs., 10 figs., 4 tabs.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 14227, 14241, 15514, 15961, 15966, 16004, 16145, 16146, 16148, 16154

15980 (IAEA-TECDOC—476) **Isotope techniques for studying the fate of persistent pesticides in the tropics. Report of the final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques held in Bangkok, 25-29 January 1988.** (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). Oct 1988. 132p. (CONF-8801149—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW.

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The coordinated research programme reported here was established in 1982 to investigate the fate of commonly used persistent pesticides, under a range of tropical and sub-tropical conditions. At the third and final meeting in Bangkok, Thailand 1988, fourteen papers were presented by nine participants. These studies demonstrated clearly that DDT and lindane do not behave in tropical soils in the same way as they do in temperate soils. They support data that show that persistent pesticides dissipate much faster in the tropics than in temperate climates. Refs, figs and tabs.

15981 (IAEA-TECDOC—476, pp 9-18) **Studies on degradation and dissipation of DDT in a sandy loam soil under laboratory and field conditions.** Hussain, A.; Babar, Zaheer-Ud-Din; Tirmazi, H. (Nuclear Inst. for Agriculture and Biology, Faisalabad (Pakistan); Government College for Women, Faisalabad (Pakistan)). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The degradation and dissipation of /sup 14/C-p,p'-DDT in sandy loam soil were investigated under laboratory and field conditions. CO/sub 2/ and organic volatiles were simultaneously determined under laboratory conditions, using a system where organic volatiles are absorbed by polyurethane plug while allowing /sup 14/Co/sub 2/ to pass through to be absorbed in alkali solution. The results showed a flush of /sup 14/C mineralization and volatilization of organics during the first 10 days; loss of /sup 14/C as CO/sub 2/ was 4 times as high as organic volatiles. Under field conditions, DDT showed a much faster dissipation rate as compared to laboratory conditions. There was no overall difference in the dissipation rates of irrigated and non-irrigated treatments. Under laboratory conditions, DDT showed a half-life of 809 days whereas under field conditions it was 120 and 112 days in irrigated and non-irrigated treatments, respectively. The main degradation products of p,p'-DDT in soil were found to be p,p'-DDE and p,p'-DDD. Bound /sup 14/C-residues accounted for 15-17% of the total residues after one year. (author). 10 refs, 1 fig., 5 tabs.

15982 (IAEA-TECDOC—476, pp 19-26) **Persistence of /sup 14/C-DDT in tropical soils of Kenya.** Wandiga, S.O.; Mghenyi, J.M. (Nairobi Univ. (Kenya). Dept. of Chemistry). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The persistence of DDT in tropical soils in Kenya was studied by conducting field experiments at two sites of fairly different climatic conditions and types of soil. Surface treatment with the radiolabelled pesticide was done in the dry season just before the onset of the short rains. The pesticide dissipated more rapidly in both sites than reported for the temperate regions. The final soil burden of the pesticide was about 28% after 217 days and 36% after 122 days of the initial concentrations for the Nairobi and Mombasa sites, respectively. The time for 50% loss of radioactivity was found to be 78 and 90 days for the Mombasa and Nairobi experimental sites, respectively. (author). 15 refs, 2 figs, 4 tabs.

15983 (IAEA-TECDOC—476, pp 27-39) **Persistence and fate of /sup 14/C-p,p'-DDT in an Indian sandy loam soil under field and laboratory conditions.** Samuel, T.; Pillai, M.K.K. (Delhi Univ. (India). Dept. of Zoology). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

Dissipation, binding and degradation of /sup 14/C-p,p'-DDT were studied for one year in a sandy loam soil of Delhi, India, after surface treatment during monsoon, winter and summer seasons under field conditions. DDT dissipated rapidly during the initial 60 days but in the final six months there was no appreciable loss of DDT. After one year, the soil contained 33 to 36% of the initial radiocarbon. Only 8% of the initial dose of DDT was bound to the soil after one year which accounted for 24% of the total residue. The calculated T/sub 50/ values for DDT ranged from 234 to 317 days although the observed time for 50% loss of DDT varied from only 60 to 120 days. Laboratory studies have shown that both mineralization and volatilization increased with rise in temperature. Volatilization appeared to be the major pathway of DDT loss and it showed a four-fold increase with rise in temperature from 15 to 45 deg. C. Also, higher temperatures enhanced degradation as well as binding of DDT. When flooded and non-flooded soils treated with DDT in quartz, glass and dark tubes were kept under sunlight for 42 days during summer, enhanced mineralization, volatilization and degradation of DDT were observed. Flooding the soil decreased mineralization but increased volatilization which accounted for the bulk of DDT lost. DDE was the major metabolite in both soil and volatile organics, although DDD was formed in larger amounts in the flooded samples. Binding and degradation of DDT were enhanced by both sunlight and flooding. The data indicate that the rapid loss of DDT under Indian conditions is due mainly to higher rates of volatilization influenced by higher soil temperature and intense solar radiations. 15 refs, 5 figs, 3 tabs.

15984 (IAEA-TECDOC—476, pp 41-45) **Dissipation and degradation of /sup 14/C-DDT in Malaysian soils.** Kadir, H.A. (Malaya Univ., Kuala Lumpur (Malaysia)). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The rates of dissipation and degradation of the insecticide DDT were studied under field conditions in Malaysia, using a /sup 14/C-labelled chemical. Over a period of one year, extractable, soil-bound and total /sup 14/C-activity were recorded. Half of the /sup 14/C-activity dissipated from soil after 24 weeks. Extractable DDT showed a half-life of only 10 weeks; 90% of the chemical dissipated after 20 weeks. The formation of DDE as a principal metabolite increased with time and accounted for approx. 60% of the extractable residue after 20 weeks. There was also a gradual significant increase in the formation of soil-/sup 14/C-bound residues which reached 50% of the total residue after 52 weeks. The data strongly

suggest the near-complete dissipation of DDT in less than half a year; the major products (50% of the initially applied chemical) being extractable DDE and bound pesticide residues. (author). 3 refs, 2 tabs.

15985 (IAEA-TECDOC—476, pp 47-52) **Behaviour of / sup 14/C-DDT in Sudan Gezira soil.** Abdalla, A.M.; El-Zorgani, G.A. (Agricultural Research Corp., Wad Medani (Sudan). Pesticide Lab.). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

Field cylinders as described in the model experiment for determination of /sup 14/C-DDT in Sudan Gezira soil were prepared and samples were collected for determination of /sup 14/C-activity at various intervals. About 83-87% of the applied radioactivity was recovered in the extracts from the top 10 cm layer of soil. The loss rate of the chemical from soil increased with time apparently by volatilization and thermal degradation due to high soil temperature, intensive solar radiation and low soil organic matter. This resulted in a half-life of approx. 5 weeks. The major part of the chemical and possible metabolites were detected in the top 10 cm layer. Approximately 8-10% of the applied /sup 14/C was detected in samples collected after 16-20 weeks. TLC and autoradiography indicated the presence of p,p'-DDT and p,p'-DDE as the major metabolite. Also traces of TDE were detected in some samples. These results showed that under Sudanese tropical conditions, DDT dissipates very rapidly in soils compared to dissipation in temperate regions. (author). 6 refs, 2 tabs.

15986 (IAEA-TECDOC—476, pp 53-59) **Behaviour of / sup 14/C-DDT in soil under field and laboratory conditions in Brazil.** Mercedes Andrea, M. de; Flores-Ruegg, E. (Radioisotope Centre, Sao Paulo (Brazil). Biological Inst.). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The fate of /sup 14/C-DDT in soil was studied during a year, under ambient and high temperatures in the laboratory, and in soil columns in the field. A loam soil, rich in organic matter (8.65%) was selected. In the laboratory test, the treated soil was contained in jars with foam (plugs as traps for volatile organics) in the top and the moisture content was maintained constant. Half of the jars were kept under ambient temperature and the other half maintained at 34 deg. C. The field test studied the mobility of /sup 14/C-DDT in soil columns at ambient climatic conditions. All samples were exhaustively extracted with methanol and wet combustions of extracted samples were done. Quantification of /sup 14/C was performed by liquid scintillation counting. One year after application, the recoveries were 82.18% at ambient temperature and 81.74% at 34 deg. C in the laboratory. Less than 1% was collected in the foam traps as volatilized materials. About one third of radiocarbon in the field columns dissipated in the first two weeks probably due to volatilization. After two weeks, dissipation was slow and /sup 14/C-activity declined to 47.8% (39.4% extractable and 8.4% bound) after 48 weeks. /sup 14/C-DDT was almost immobile, even under two rainy periods, because very little was detected below the 0-10 cm section. (author). 9 refs, 1 fig., 2 tabs.

15987 (IAEA-TECDOC—476, pp 63-68) **Fate of /sup 14/C-DDT in Thailand under field and laboratory conditions.** Tayaputch, N. (Department of Agriculture, Bangkok (Thailand). Div. of Agricultural Toxic Substances). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The dissipation of /sup 14/C-DDT from field soils was studied for a period of 110 weeks. Analysis of extractable residues showed that radiocarbon was mainly associated with the soil top layer (0-9 cm). Under the experimental conditions, dissipation was generally very slow during the first 54 weeks and fairly rapid during the 55-110 week period. Only 26-31% of the initial activity was recovered after 110 weeks of which 29% of the total residue was bound. Extractable residues included DDT, DDE and TDE of both o,p and p,p isomers. In the laboratory, three types of soil produced 0.03-0.09% and 1.22-1.59% of mineralized /sup 14/C during 20 weeks for sterile and non-sterile soils, respectively. Methanol extracts from non-sterile soils contained p,p'-DDE as a principal metabolite. (author). 7 refs, 1 fig., 3 tabs.

15988 (IAEA-TECDOC—476, pp 69-76) **Degradation of DDT in a Florida sandy soil under subtropical environmental conditions.** Wheeler, W.B.; Stratton, G.D. Jr.; Edelstein, R.L. (Florida Univ., Gainesville, FL (USA). Pesticide Research Lab.). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

/sup 14/C labeled DDT was applied to a low organic matter, sandy soil. Soils were divided into three moisture regimes, dry (4.6% moisture), field capacity (6.7% moisture) and saturated (23% moisture). Soils were incubated at 35 deg. C for 12 hours and 27 deg. C for 12 hours each day, for a period of 677 days. Samples were taken at various intervals and extracted, and the /sup 14/C was quantified as aqueous soluble, organic soluble and non-extractable. Losses of /sup 14/C were as much as 77% after 677 days. Greater than 80% of the organic soluble /sup 14/C was p,p'-DDT. The dry soil treatment exhibited lower percentages of organic soluble /sup 14/C and higher percentages of aqueous soluble /sup 14/C than did the two other soil moisture treatments throughout much of the incubation period. Half-lives of all treatments exhibited a biphasic nature: an initial rapid decline over the first 98 days followed by a slower decline for the remaining period. Estimates of half-lives of the organic soluble fractions ranged from 62.5 to 2,365 days. The dry soil tratment exhibited these extremes while the other soil treatments were similar to each other and ranged from 134 to 380 days. Despite the dissimilarities in behavior, the quantities of p,p'-DDT remaining in the three treatments at 677 days were comparable. (author). 1 ref, 5 figs, 1 tab.

15989 (IAEA-TECDOC—476, pp 77-84) **Persistence of γ-1,2,3,4,5,6-hexachlorocyclohexane (γ-HCH) in tropical soils of Kenya.** Wandiga, S.O.; Mghenyi, J.M. (Nairobi Univ. (Kenya). Dept. of Chemistry). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The persistence of γ-HCH (lindane) was studied in field experiments at two sites of fairly different climatic conditions. The dissipation of radiolabelled pesticide was followed by analysing the residual radioactivity in soil samples collected from the plots at specified intervals after application. The time for 50% loss of pesticide was low, i.e. 5 and 8 days for the Mombasa and Nairobi experimental sites, respectively. Levels of pesticide residues that become bound in the soil increased with time after the application of the pesticide. (author). 12 refs, 2 figs, 3 tabs.

15990 (IAEA-TECDOC—476, pp 85-91) **Persistence of lindane in the Ecuadorian environment.** Bolanos Moreno, M. de; Espinosa, L.; Pastor, Y.; Molineros, J.; Merino, R. (Ministry of Agriculture and Livestock, Quito (Ecuador); Comision Ecuatoriana de Energia Atomica, Quito). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

Dissipation and degradation rates of /sup 14/C-lindane in coastal and highland areas of Ecuador were investigated over a one year period. The labelled compound was incorporated into the top layer of soil in rigid PVC tubes driven into the soil. In the highlands, the lindane half-life was 8 weeks, while at the coast 9 weeks indicating much higher dissipation rates than those reported for

temperate zones. In both places, the applied labelled compound was found only in the surface layer (0.7.5 cm depth) indicating lack of movement of the pesticide into the soil. This suggests that even heavy rainfall does not carry the compound down into the soil. (author). 4 refs, 1 fig., 2 tabs.

15991 (IAEA-TECDOC—476, pp 93-102) **Persistence and fate of /sup 14/C-gamma-HCH in an Indian sandy loam soil under field and laboratory conditions.** Samuel, T.; Pillai, M.K.K. (Delhi Univ. (India). Dept. of Zoology). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The persistence, binding and degradation of /sup 14/C-gamma-HCH were studied for one year under field conditions in Delhi, India. The surface treatment of HCH to a sandy loam soil during the monsoon, winter and summer seasons resulted in rapid dissipation in the initial 60 days. However, less than 1% of the initial HCH was lost in the final six months. After one year, the soil burden of HCH was about 15% of the initial concentration, of which bound residues accounted for more than three quarters. The observed time for 50% dissipation of HCH varied from 30 to 45 days although the calculated T/sub 50/ values ranged from 124 to 147 days. Incubation of HCH treated soils at 15, 30 and 45 deg. C showed increased CO/sub 2/ evolution and volatilization at higher temperatures. Volatilization was predominant and showed a six-fold increase with rise in temperature from 15 to 45 deg. C. Higher temperatures also enhanced degradation and binding of HCH. When HCH-treated soil samples in quartz, glass and dark tubes were kept under sunlight for 42 days, higher rates of mineralization and volatilization occurred in the quartz tubes. The major loss of HCH was due to volatilization which was enhanced further by flooding the soil. Similarly, degradation of HCH to PCCH was also influenced by sunlight, while flooding resulted in further degradation to TCCH. The present studies demonstrated that under Indian subtropical conditions HCH dissipated rapidly by volatilization, evidently due to higher soil temperature and intense solar radiations. (author). 9 refs, 4 figs, 3 tabs.

15992 (IAEA-TECDOC—476, pp 103-111) **Study of / sup 14/C-lindane in an aquatic ecosystem model.** Enan, E.; El-Hawari, B.; El-Masry, M.; Enan, O. (Alexandria Univ. (Egypt). High Inst. of Public Health). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

The study was carried out by treating 100 gm soil with 5 μCi of /sup 14/C-lindane. The untreated and treated soils were layered on the bottoms of separate all glass aquarium tanks prepared as aquatic ecosystem models. The experiments were done at pH 7.0, 8.2 and 5.5 and at 35 deg. C, 25 deg. C and 15 deg. C in complete darkness and light for 60 days. The data obtained revealed that at the higher temperature there was higher loss of /sup 14/C from treated soil. Also the acidity of the media reduced the efficiency of /sup 14/C-recovery from the soil at 25 deg. C and 15 deg. C. The distribution and bioaccumulation ratio (BR) of radioactive material by fish was higher than that of algae and snail. Furthermore, BR of fish and snail proved to be pH dependent. The BR of algae was generally higher in the light than in the dark. The total recovery of /sup 14/C-lindane in the light was higher than in the dark under all conditions of the experiment. It can be also concluded that the amount of radioactive material recovered from soil or trapped as / sup 14/CO/sub 2/ was to some extent pH dependent. (author). 9 refs, 1 fig., 4 tabs.

15993 (NP—9770227) **Investigations on heavy metal solubility in contaminated soils and composts of municipal wastes due to soil reaction, redox potential and element content.** Herms, U. (Kiel Univ. (Germany, F.R.). Agrarwissenschaftliche Fakultaet). 21 Oct 1982. 278p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE89770227/JAW.

Chemical characteristics of heavy metals as cadmium, lead, zinc and copper in soils and composts of municipial wastes have been investigated. Solubility due to different redox potentials, pH-values and element concentrations of calcium and chlorides have been tested. The results are described and discussed in detail.

15994 (PNL-SA—16465) **Permeability of air and immiscible organic liquids in porous media.** Cary, J.W.; Simmons, C.S.; McBride, J.F. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 22p. (CONF-881222—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005162/JAW.

From ASAE international symposium on modeling agricultural, forest, and rangeland hydrology; Chicago, IL, USA (12 Dec 1988).

The conductivity of mineral oil, relative viscosity 77, Soltrol-220 oil, relative viscosity 4.7, and air were observed in three porous media, including a sand, loamy sand, and a silt loam. The observations were made over a range of water contents for each porous medium. As under field conditions, small volumes of air were present, as well as water, during most of the oil conductivity measurements. The results were compared to two methods for calculating relative conductivities of immiscible fluids in water-wet porous media. A new equation was formulated for use with these methods to account for swelling and for the gas "slippage" effect in very small pores. The observed conductivities, spanning six orders of magnitude, agree reasonably well with calculated values. Only three soil parameters are required to calculate the conductivities: (1) the saturated conductivity of water, (2) the saturated conductivity of the immiscible fluid of interest, and (3) a pore size index value that is obtained from an estimate of the porous material's water release curve. Remediation of organic liquid spills is briefly discussed. It is suggested that in light of spatial variation of soil conductivity under field conditions, the method presented for calculating values of multiphase conductivities may well be of practical value. 11 refs., 5 figs.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 14405, 14406, 15514, 15971, 15972, 15973

15995 (CEA-BIB—244) **Kyshtym riddle: possible kind of the accident.** Ballereau, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). 1988. 57p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756639/JAW.

It can been postulated from varied rumors, soviet testimonies, analysis of radioecological russian publications that a serious radiological accident occurred in late 1957 - early 1958 in the Oural mountains. Isotopic ratio /sup 90/Sr//sup 137/Cs in the environment following the accident was abnormally high. Several types of accidents has been postulated; the more credible event is an explosion in a storage tank containing dried high activity wastes and NH/sub 4/N0/sub 3/, from which /sup 137/Cs had been extracted.

15996 (CIEMAT—617) **Some analitical aspects about determination of Sr-89 y Sr-90 in environmental samples.** Gasco, C.; Alvarez, A. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 103p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756334/JAW.

Some problems about determination of Sr-89 and Sr-90 in environmental samples have been studied. The main difficulties are due to the wide range in the concentration of their components and the contents of chemical and radiochemical interferent elements. The behaviour of strontium on ion exchange resin has been described by some experiments in various media: aqueous media, calcium concentration and matrix variable. The differences of alkaline-earth nitrate and carbonate solubilities have been analyzed in nitric acid. The chemical recovery in environmental samples has been determined. (Author)

15997 **(DOE-RW—88.098) Chemical speciation of technetium in the environment: a literature survey.** Sparkes, S.T.; Long, S.E. (UKAEA Harwell Lab. Environmental and Medical Science Div.). (Department of the Environment, London (UK)). Jul 1987. 30p. (AERE-R—12743). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705432/JAW.

This report reviews the current understanding of the chemical forms and behaviour of technetium in the environment. Technetium (VII) is the dominant species in most systems, however when reducing conditions arise technetium (IV) species predominate. Pertechnetate is a highly mobile ion in aqueous media and can exhibit significant environmental transfer. Technetium (IV) is readily sorbed by sediments and is able to complex with various ligands which subsequently determine its fate. Complexation with high molecular weight organic moieties reduces the availability of technetium although this is not necessarily the case with smaller molecules. In plants, technetium is absorbed as TcO/sub 4//sup -/ and can become incorporated into organic molecules. The technetium present in such forms is generally considered less available for uptake by the ingesting animal than aqueous TcO/sub 4//sup -/, although significant transfer of this element has been reported from food into eggs. Areas of potential future interest are suggested.

15998 **Separation of americium from tervalent lanthanides for high-resolution alpha spectrometry.** Sill, C.W. (EG and G Idaho, Incorp., PO Box 1625, Idaho Falls, ID (US)). pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

One of the biggest problems encountered in the determination of americium-241 in large samples of soil by alpha spectrometry is caused by the relatively large quantity of lanthanides present naturally. Their chemical behavior is so similar to that of the tervalent actinides that any present carries through the chemical separations to the final americium fraction and causes severe degradation of the subsequent alpha spectrum. The resolution must be good enough to resolve the americium-241 peak from that of the americium-243 tracer being used to determine the chemical yield. The major branches of the two radionuclides are separated by only 211 keV, and there are minor branches in between the two main peaks that are separated by only 37 keV. The average abundance of combined scandium, yttrium, lanthanum, cerium, praseodymium, neodymium and samarium in the crust of the earth is about 190 μg/g is cerium. The cerium can be separated easily after oxidation to its quadrivalent state form the other lanthanides which are nonoxidizable but the quantity of the latter remaining is still far too large to permit a 10-g sample to be used. Consequently, most procedures are either limited to a 1-g sample, which results in a loss of sensitivity and precision that is unacceptable for many purposes, or the lanthanides must be separated by fractionation techniques that are generally laborious and inefficient.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 14976, 15979

52 ENVIRONMENTAL SCIENCES, AQUATIC

15999 **(CIEMAT—612) Measurement of very low alpha activity in water.** Crespo, M.T.; Acena, M.L. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1987. 23p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756330/JAW.

Measurement of very low levels of alpha-emitting nuclides in water needs substantial improvements. A system based on the adsorbing properties of manganese dioxide eliminates the need for trnsporting very large volumes of water and increases the sensitivity of the measurement.

5201 Basic Studies

REFER ALSO TO CITATION(S) 14506, 15978, 15979, 16001, 16174

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 14226, 14240, 14326, 15034, 15271, 15483, 15971

16000 (IA—1440, pp 176-177) **Removal of toxic metallic contaminants from industrial waste solutions and groundwater by electrochemical treatment with porous carbon electrodes.** Oren, Y.; Soffer, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16001 (IAEA-TECDOC—476, pp 61-62) **Dissipation of /sup 14/C-DDT from field soils in Egypt.** Enan, E. (Alexandria Univ. (Egypt). High Inst. of Public Health). Oct 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705334/JAW. (CONF-8801149—).

From Final research co-ordination meeting on the fate of persistent pesticides in the tropics, using isotope techniques; Bangkok, Thailand (25 Jan 1988).

16002 **(LA—10300-M-Vol.2) Health and Environmental Chemistry: Analytical techniques, data management, and quality assurance.** Gautier, M.A.; Gladney, E.S. (eds.). (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 131p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006697/JAW.

This section of the manual has been prepared to document the analytical methodology used by the Los Alamos National Laboratory Health and Environmental Chemistry Group. It is part of the overall quality control effort to support the health, safety, and environmental programs at the Laboratory. The section provides analytical methods for the monitoring of waste discharges under the National Pollutant Discharge Elimination System. The analytical procedures were developed by the Health and Environmental Chemistry staff, were modified from standard methods developed and evaluated by the Environmental Protection Agency (EPA), or were adapted from procedures found in the literature. The procedures have been tested by chemists and technicians to prove their validity. The methods measure the concentration of the desired analytes with the precision, accuracy, and specificity required by Group HSE-7, Waste Management, and meet the needs of federal legislation. The procedures utilize equipment and skills available in modern waste water chemistry laboratories. Precision and accuracy statements are provided where such data are available. Each procedure is presented in a simple and concise manner and includes interferences, apparatus, reagent preparation, calibration methods, and data reduction formulas.

16003 **(PB—89-129118/XAB) Effects of temperature and redox conditions on degradation of chlorinated phenols in freshwater sediments.** Rogers, J.E.; Kohring, G.W.; Wiegel, J. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Nov 1988. 23p. (EPA—600/3-88/048). NTIS, PC A03/MF A01.

The effect of temperature and redox conditions on the anaerobic degradation of 2,4-dichlorophenol (2,4-DCP) was investigated in anaerobic sediment slurries, prepared from local freshwater pond sediments. Under methanogenic conditions, 2,4-DCP dechlorination occurred in the temperature range between 5 and 50 C. Although dechlorination was not observed above 50 C, anaerobic bacterial activity was indicated by methane formation up to 60 C. In sediment samples from two sites and at all temperatures from 5 to 50 C, 2,4-DCP was transformed to 4-chlorophenol (4-CP). The 4-CP intermediate was subsequently degraded after an extended lag period. Adaptation periods for 2,4-DCP transformation decreased between 5 and 25 C, were essentially constant between 25 and 35 C, and increased between 35 and 40 C. Degradation rates increased exponentially between 15 and 30 C, had a second peak at 35 C, and de-

creased to about 5% of the peak activity by 40 C. In one sediment sample, an increase in degradation rates was observed following the minimum at 40 C, suggesting that at least two different organisms were involved in the 2,4-DCP dechlorination. Storage of the original sediment slurries for 2 months at 12 C resulted in increased adaptation times but did not affect the degradation rates.

16004 **(PB—89-129373/XAB) US Environmental rotection Agency's strategy for ground-water-quality monitoring at hazardous-waste land-disposal facilities located in karst terranes.** Field, M.S. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Nov 1988. 10p. (EPA—600/D-88/241). NTIS, PC A02/MF A01.

Ground-water monitoring of hazardous-waste land-disposal units by a network of wells is ineffective when located in karstic terranes. The U.S. Environmental Protection Agency (EPA) is currently proposing to modify its current ground-water-quality monitoring requirement of one upgradient well and three downgradient wells for disposal units located in karstic terranes. The convergent nature of subsurface flow to cave streams in karstic terranes requires that effective monitoring wells intercept the cave streams. Wells located around a hazardous-waste disposal unit, but not in the specific cave stream draining the site, are only providing irrelevant data and a false sense of security because the water samples from such wells are not necessarily from the hazardous-waste disposal unit. A case study is provided in this paper. EPA is drafting a guidance document that will allow monitoring by wells, only if the up- and down-gradient wells can be demonstrated to be hydraulically connected by means of dye-trace studies. If not, then the monitoring of springs shown to be hydraulically connected to the facility by dye-tracing studies would be required. Monitoring for sinkhole development will also be required to provide advance warning of sinkhole collapse. The investigation and determination of the probability of sinkhole collapse is given special treatment.

16005 **(UCRL—21063) Health risk assessment of cis-1,2-dichloroethylene in California drinking water.** Mallon, B.; Hall, L.C.; Hsieh, P.; McKone, T.E. (Lawrence Livermore National Lab., CA (USA)). 24 Jan 1989. Contract W-7405-ENG-48. 72p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007228/JAW.

This document presents an assessment of the potential health risks associated with exposure to cis-1,2-dichloroethylene (cis-1,2-DCE) dissolved in California drinking waters. This assessment is being provided to the California Department of He .h Services (CDHS) for the development of drinking-water standards to manage the health risks of cis-1,2-DCE exposure. Other assessments required in the risk-assessment process include analyses of the technical and economic feasibilities of treating water supplies contaminated with cis-1,2-DCE. A primary goal of this health-risk assessment is to evaluate dose-response relationships for observed and potential toxic end points of cis-1,2-DCE in order to define dose rates that can be used to establish standards that will protect members of the general public from adverse health effects resulting solely from water-based exposures to cis-1,2-DCE. We also analyze the extent of human exposures attributable to cis-1,2-DCE-contaminated groundwater in California.

16006 **Apparatus for ground water chemistry investigations in field caissons.** Cokal, E.J. (Environmental Science Group (LS-6), Mail Stop K495, Los Alamos National Lab., Los Alamos, NM (US)). pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

Los Alamos is currently in its second season of ground water chemistry and hydrology experimentation in a field facility that incorporates clusters of six, 3-meter diameter by 6-meter deep, soil-filled caissons and required ancillaries. Initial experience gained during the 1983 field season indicated the need for further development of the technology of this type of experimentation. This paper discusses the experimental results of this study.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 14378, 15514, 15971, 15972, 15973, 15995, 15996, 16139

16007 (IA—1440, pp 262-263) **Measurement of the purification efficiency of a personal water purification kit (Na/sup 131/I contamination).** Izak-Biran, T.; Tal, A.; Klopfer, J.; Israeli, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16008 **(IAEA-TECDOC—481) Inventories of selected radionuclides in the oceans.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 181p. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88705464/JAW.

In March 1984 an ad hoc Review Committee composed of senior experts in the marine radioactivity field made recommendations that "the Monaco Laboratory should be engaged in compiling and evaluating the input of radionuclides into the marine environment". The Committee recommended that work should commence on selected radionuclides, viz., /sup 14/C, caesium isotopes, plutonium isotopes, /sup 210/Po and /sup 210/Pb followed by /sup 226/Ra. Depending on the radionuclides involved the assistance of competent experts from outside as well as inside the IAEA was sought. The present document is a product of the work carried out within the framework of the above-mentioned task and contains reports on /sup 14/C, /sup 90/Sr, /sup 137/Cs, /sup 238/Pu, /sup 239+240/Pu, /sup 210/Pb, /sup 210/Po and /sup 226/Ra. Although the estimation of the inventory in the marine environment and related input and output fluxes, is the same for all radionuclides concerned, different approaches were followed to achieve this objective. These approaches depended on the geochemical characteristics of the radionuclides and the availability of data for different times and locations. For regions where data were lacking, extrapolation on the basis of specific assumptions has often been necessary. As the work was initiated during the pre-Chernobyl period, the radionuclides derived from the Chernobyl incident were not, in general, considered. Since the work for preparing the forthcoming report of the UNSCEAR is scheduled to be completed by 1991, it is hoped that the information contained in this volume will be beneficial. Refs, figs and tabs.

16009 **(INFO—0231-1) Survey of data on the radionuclide content of fish in Canada.** (Atomic Energy Control Board, Ottawa, Ontario (Canada); Beak Consultants Ltd., Toronto, Ontario (Canada)). Jan 1987. 74p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705374/JAW.

See INFO--0231-2 for Appendix.

A computerized database of uranium and thorium decay-series radionuclide concentrations in Canadian fish was compiled, including concentrations of U-total, Th-total, Th-230, Th-232, Th-228, Ra-226, Po-210 and Pb-210 in various fish tissues. Each record represents a specific tissue from a particular fish sample, indexed by province, lake or river of origin, nearest mine/mill, mine status, distance to mill, sampling date, fish species, tissue type, weight basis of measurement, analytical laboratory, and a number of data quality factors. Additional information includes exact location, UTM coordinates, sample collector, literature reference, fish weight, length, age and sex, number of fish, and radionuclide concentrations in water and sediment. Records are retrievable by any combination of index variables, radionuclide ranges and/or data quality criteria. The database uses the DBase II software package. 51 refs.

16010 (INIS-mf—11348, pp 86) **Speciation and distribution of radioactive cobalt in aquatic systems.** Hansen, A.M.; Galvan, F.A.; Leckie, J.O. (Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares; Stanford Univ., CA (USA). Dept. of Civil Engineering). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16011 (INIS-mf—11348, pp 119) **Characterization of aquifers by means of the determination of uranium and radon concentration in water.** Segovia, N.; Olguin, M.T.; Bulbulian, S.; Iturbe, J.L.; Ordonez, E.; Carrillo, J. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16012 (INIS-mf—11348, pp 121) **Determination of radon in aquifers.** Quirino T, L.L.; Escareno J, E. (Universidad Autonoma de Zacatecas (Mexico). Centro Regional de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16013 **Effluent monitoring and urinalysis at the Oak Ridge Y-12 Plant.** Hinton, E.R.; White, L.E.; Goodwin, W.L.; Rogers, E.R. (Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., PO Box Y, Oak Ridge, TN (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

Within the last five years, the Y-12 Plant Laboratory has purchased five Scintrex UA-3 uranium analyzers. This paper describes the use of the Sintrex UA-3 for on-line effluent monitoring and for determining total uranium in urine analyses. The uranium effluent monitor is a compact electro-optical instrument for the measurement of trace uranium in aqueous solutions, including naturally occurring water (such as surface water from lakes, rivers, and groundwater), and from various process streams (such as storm sewers, steam condensates, and raffinates). The measurements made by the UA-3 Effluent Monitor are based on the fluorescence of a uranyl complex formed by the addition of a reagent to the sample during analysis. Analysis with a sensitivity better than 1.0 ppb of uranium can be made without preconcentration or treatments of the sample, even in the presence of many potentially interfering species. As constructed, the basic instrument provides a linear working range of approximately 1.0 to 20.0 ppb. By suitable addition of correct metering pumps on the sample inlet line, this working range can easily extend well into the ppm or low percent level.

16014 **Development of a mechanism for the radiolysis of ground waters containing iron.** Nicolosi, S.L. (Battelle, Columbus Labs., 505 King Avenue, Columbus, OH (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

The performance of a high level nuclear waste repository is dependent upon the performance of the individual waste packages which contain the radioactive waste materials. Designs of these waste packages generally call for the use of a metallic barrier(s) which provides a level of containment for the radioactive waste materials. The performance of these waste packages, as specified in 10CFR60, is dependent upon the time to containment failure and the release rates of radionuclides subsequent to the time of containment failure. The performance of the metallic barrier providing containment of the radioactive waste materials is dependent upon factors such as those which affect its corrosion rate and resistance to stress. The authors are therefore developing a generalized model that will provide this information for several different ground waters. This model will account for the presence of corrosion products as well as other repository materials (such as packing material) which may become dissolved in the ground water. The work which is presented shows the basis mechanism for the radiolysis of pure water and benchmark calculations which are compared with results from the literature. Comparisons with other mechanisms presented in the literature are also shown. Also presented are the elementary reactions added to this mechanism to account for the presence of iron ions dissolved in water.

5205 Site Resource And Use Studies

16015 **(PB—89-128458/XAB) Fiscal year 1987 program report: New Hampshire Water Resources Research Center.** Ballestero, T.P. (New Hampshire Univ., Durham (USA). Water Resources Research Center). Aug 1988. 31p. NTIS, PC A03/MF A01.

See also report for FY 86, PB—88-132808.

The report covers the activities of the New Hampshire Water Resources Research Center for the period July 1, 1987 through June 30, 1988. The results of five research projects are briefly discussed. Projects include: drinking-water treatment, cloud-water and wet-deposition chemistry, hydraulic mounding under community septic systems, ground-water chemistry as it relates to radionuclides, and recodification of water laws. Two Information Transfer projects are also summarized: a hydrologic field facility and an Environmental Seminar series.

16016 **(PB—89-128763/XAB) Maintenance of flows downstream from water-development projects in Colorado, Montana, and Wyoming.** Raley, C.; Hubert, W.; Anderson, S. (Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie (USA)). Aug 1988. 83p. (BIOLOGICAL—88(27)). NTIS, PC A05/MF A01.

See also PB—89-128771.

All known water projects in Colorado, Montana, and Wyoming with streamflow agreements and data on streamflows below the project were examined to assess the frequency of discrepancies between agreed-to and actual flows. A total of 73 water development projects were identified, involving 119 locations with minimum streamflow agreements. Of these 61 locations, 54 exhibited flows below those established in streamflow agreements on at least some occasions; 28 locations had flows 25% of the established agreement or less. These data are summarized by State, agency, and type of agreement in the main report. An appendix (bound separately) presents detailed data on each of the water development projects examined.

16017 **(PB—89-128771/XAB) Maintenance of flows downstream from water-development projects in Colorado, Montana, and Wyoming. Appendix A.** Raley, C.; Hubert, W.; Anderson, S. (Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie (USA)). Aug 1988. 127p. (BIOLOGICAL—88(27)-A). NTIS, PC A07/MF A01.

See also PB—89-128763.

All known water projects in Colorado, Montana, and Wyoming with streamflow agreements and data on streamflows below the project were examined to assess the frequency of discrepancies between agreed-to and actual flows. A total of 73 water development projects were identified, involving 119 locations with minimum streamflow agreements. Of these 61 locations, 54 exhibited flows below those established in streamflow agreements on at least some occasions; 28 locations had flows 25% of the established agreement or less. These data are summarized by State, agency, and type of agreement in the main report.

16018 **(TVA/RD/WQ—89/1) Assessment of bacterial contamination in the Bear Creek Floatway, 1988.** Springston, G.L.; Milligan, J.D. (Tennessee Valley Authority, Chattanooga (USA). Div. of Water Resources). Nov 1988. 73p. NTIS, PC A04/MF A01 - OSTI. Order Number DE89006437/JAW.

To evaluate the closure status of the floatway, TVA began further monitoring of Bear Creek Floatway to assess the health implications of new criteria relative to fecal coliform and fecal streptococcal contamination. Data were collected for fecal coliform, fecal streptococci, enterococci, and Escherichia coli. Data collection began in April 1984. Results and evaluation of data from May 1985 to July 1986 are reported herein. 6 refs., 3 figs., 3 tabs.

5206 Regulations

REFER ALSO TO CITATION(S) 16005

53 Environmental-social Aspects Of Energy Technologies

REFER ALSO TO CITATION(S) 14855

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 14242, 14243, 14244

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 16616, 16617

16019 **(ANL—88-45) Proceedings of the workshop on advanced computer technologies and biological sequencing.** (Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 72p. (CONF-8811151—Summs.). NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007096/JAW.

From Workshop on advanced computer technologies and biological sequencing; Argonne, IL, USA (3 Nov 1988).

The participants in the workshop agree that advanced computer technologies will play a significant role in biological sequencing. They suggest a strategy based on the following four recommendations: define a set of model projects, and develop a complete set of data management and analysis tools for these model projects; seek to consolidate appropriate databases, while allowing for the flexible development and design of tools that will permit further consolidation, In the longer term, develop a coordinated effort that will allow networking of all relevant databases; encourage the development, collection, and distribution of analysis tools; and address user interface issues and encourage the development of graphics and visualization tools. Section 3 of this report elaborates on each of these recommendations. Section 2 contains the tutorials presented at the workshop and a summary of the comments made in the discussion period following the tutorials. These tutorials were an integral part of the workshop: they provided a forum for the discussion of the needs of biologists in managing and analyzing biological sequencing data, and the capabilities of advanced computer technologies in meeting those needs. Also included in Section 2 is an informal paper on fifth generation technologies, prepared by two of the participants. Appendix A contains the documents (edited for grammar) prepared by the participants and groups at the workshop. Appendix B contains the workshop program.

5502 Biochemistry

REFER ALSO TO CITATION(S) 14477, 14517, 14518, 14519, 14520, 14529, 15508, 15600, 16025, 16069, 16071, 16118, 16150, 16155

16020 **(DOE/ER/60597—T1) Continuing experimental investigations with radiolabeled anti-collagen antibodies and related antibodies: Progress report, May 1, 1989--April 30, 1990.** Gottschalk, A. (Yale Univ., New Haven, CT (USA). Dept. of Diagnostic Radiology). [1989]. Contract FG02-87ER60597. 19p. NTIS, PC A03 - OSTI. Order Number DE89006749/JAW.

Laminin is a protein which codistributes with collagen IV (a component of basement membrane). Although the precise relationship of these proteins is somewhat controversial (discussed below), investigators agree that although collagen IV and laminin are different proteins, their codistribution in basement membrane is quite comparable. We have hypothesized that injury (particularly radiation lung injury) will damage basement membrane and therefore expose laminin at some point in the injury or repair process. Consequently, anti-laminin antibody uptake (Lam-1) should relate to the injury process, and scintigraphy of radiolabeled anti-laminin antibody has the potential of developing an in vivo noninvasive probe to monitor tissue injury. We developed the techniques to set up an irradiation lung model, and will review these briefly in the section below entitled Preliminary Technical Concerns. Subsequently, in the past year, we have utilized these methods to develop an experimental model for irradiation lung injury with computerized scintigraphic output which correlates extremely well with in vitro uptake measurements, and has characteristic histopathologic findings. In short, we believe we have developed a noninvasive in vivo probe for detecting irradiation lung injury using anti-laminin antibody (Lam-1) as the scintigraphic tracer.

16021 **(DOE/EV/03280—T6) Differentiation and carcinogenesis: An integrated multilevel study of mechanisms from molecules to man: Final progress report, December 1, 1983--January 31, 1988.** Ts'o, P.O.P. (Johns Hopkins Univ., Baltimore, MD (USA). School of Hygiene and Public Health). Jan 1989. Contract AC02-76EV03280. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006921/JAW.

This research program has been an integrated, multiple level study of the mechanism of differentiation and carcinogenesis from molecules to man, with emphasis on the development of new experimental procedures and new concepts. The research program consisted of three projects: I - Animal and Cell Biology: Progenitor Cells in Differentiation and Carcinogenesis - Mesenchymal Cells; II - Molecular Biology and Molecular Cytology; and III - Technological Developments. The interrelationship among differentiation, aging, and cancer can now be investigated effectively and experimentally in view of the establishment of an extrapolation between in vivo and in vitro Syrian hamster systems. We have developed monoclonal antibodies, specific nucleic acid enzymes, and specific nucleic acid probes as reagents to investigate the properties of individual cells. We have developed powerful biological and molecular procedures to investigate DNA rearrangement, DNA methylation status, and DNA (gene) amplification. We have developed nonionic oligonucleotide analogs which can modify gene expression in living cells. We have applied powerful NMR techniques to study living systems in a non-invasive manner, particularly on water structure and activities involved in cell replication.

16022 (PB—88-162805, pp 169-204) **In search of the "ultimate map" of the human genome: The Japanese efforts.** Yoshikawa, Akihiro. Feb 1988. NTIS, PC A10/MF A01 - OSTI. Order Number TI88010822/JAW.

In Mapping our genes: Federal genome projects: How vast? How fast? Contractor reports, Volume 2.

The Japanese efforts to sequence DNA are described and their impacts upon the US are assessed. Section 2 provides a short history of the Japanese sequencing efforts along with the roles of government ministries, business and academic advisory committees in the formation and implementation of policy. In Section 3, the emphasis on developing automated technologies in sequencing is described in detail. Plans to establish other related infrastructures, i.e., data banks and repositories, are also discussed here. In both Section 2 and 3, possible future impacts of government involvement in sequencing efforts on the commercialization of technologies are exp..red. Some technologies have been already developed through the Japanese DNA sequencing project and have already been commercialized. For example, Seiko has developed a microchemical robot for automation of the chemical and the enzymatic sequencing reactions, and Toyo Soda has developed DNA extractors with a subsidy from the government. The Human Frontier Science Program (HFSP) though not yet well defined, it is likely to affect the implementation of the sequencing effort since DNA sequencing is regarded as one of the most important technologies related to the program. Section 4 discusses the Human Frontier Science Program{endash}its goals, impacts on the sequencing efforts, and also its shortcomings. Section 5 discusses whether any international cooperation is possible. If so, in what respect? What are the difficulties? What are possible forms of international cooperations, i.e., work sharing or establishment of research funds, for the sequencing efforts? 21 refs. (DT)

16023 **Cell lines for the production of monoclonal antibodies to human glycophorin A.** Bigbee, W.L.; Fong, S.S.N.; Jensen, R.H.; Vanderlaan, M.; Langlois, R.G. (to Dept. of Energy, Washington, DC). US Patent 4,767,710. 30 Aug 1988. Filed date 15 May 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

Cloned mouse hybridoma cell lines have been established which continuously produce antibodies that differentiate between the M and N forms of human glycophorin A. These antibodies have potential application as human blood group reagents, as markers for terminally differentiated erythroid cells and as immunofluorescent labels of somatically variant human erythrocytes.

5503 Cytology

REFER ALSO TO CITATION(S) 16021, 16023, 16150

5504 Genetics

REFER ALSO TO CITATION(S) 14154, 14521, 16067, 16118

16024 **(DOE/ER/60697—1) Improved mutagen-testing systems in mice: Progress report, June 1, 1988--May 31, 1989.** Roderick, T.H. (Jackson Lab., Bar Harbor, ME (USA)). Jan 1989. Contract FG02-88ER60697. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006987/JAW.

In December we injected 20 mice with 250 mg/kg of ENU. Half of the mice were males of C57BL/6J and half were males of strains AEJ/GnRk. The strains were chosen to include a standard widely used strain (C57BL/6J) but also to include a strain (AEJ/GnRk) that has an unusually large litter size (mean = 10) to promote better survival of embryos with induced recessives. Sentinal females are in with the treated males to determine return to fertility of the injected males. All males will be mated with the new lethal test system. Lethal No. 1 has now been clearly determined to be just distal to the distal breakpoint of inversion In(1)1Rk. All other lethals, including the new lethal No. 8 are crossed with our specially constructed stocks for linkage analysis. Also, the lethals are being crossed with known recessive markers along the inverted segment to determine possible allelism. All lethals have been intercrossed to determine whether they complement each other. Wild type animals should not be recovered if the lethals are overlapping. In a new study we are examining the wild type animals from each of these crosses carefully for general phenotypic conformation, eye disorders, feet, body weight and gait. Although these lethals may be complementary, it is possible that some interactive effects could be produced in an animal doubly heterozygous for different deletions.

16025 (PB—88-162805, pp 1-34) **The mapping and sequencing of genomes: A comparative analysis of methods, benefits and disbenefits.** Mount, S.M. Feb 1988. NTIS, PC A10/MF A01 - OSTI. Order Number TI88010822/JAW.

In Mapping our genes: Federal genome projects: How vast? How fast? Contractor reports, Volume 2.

A status report is provided for genetic maps and DNA sequence informations for several well studied species and how the experienced gained in acquiring this information will relate to the proposed Human Genome Project. From these studies recommendations are made as to the development of improved technology, funding for the program, policy matters, and information processing. 26 refs., 2 figs. (DT)

16026 (PB—88-162805, pp 35-73) **Mapping the human genome: Experimental approaches for cloning and ordering DNA fragments.** Myers, R.M. Feb 1988. NTIS, PC A10/MF A01 - OSTI. Order Number TI88010822/JAW.

In Mapping our genes: Federal genome projects: How vast? How fast? Contractor reports, Volume 2.

This report describes current methodology used to locate a gene on its chromosome and addresses experimental approaches to the construction of a physical map of the human genome. The procedure outlined is to isolate each human chromosome, to break each chromosome into fragments of one to several million base pairs (bp) in length, to subdivide each fragment into overlapping 40,000 bp units for construction of cosmid libraries, restriction mapping of the cosmids, and finally linking the restriction maps to form a complete physical map. 56 refs., 3 figs. (DT)

16027 (PB—88-162805, pp 75-130) **Mapping and sequencing the human genome in Europe.** Newmark, P.A. Feb 1988. NTIS, PC A10/MF A01 - OSTI. Order Number TI88010822/JAW.

In Mapping our genes: Federal genome projects: How vast? How fast? Contractor reports, Volume 2.

This report provides a discussion of current efforts by European nations in the area of mapping and sequencing of genes and/or biotechnology and further comments on public discussions concerning directed studies on the human genome. The report is organized into efforts by European community organizations, France, Federal Republic of Germany, United Kingdom, other countries, and databases. 43 refs. (DT)

5505 Metabolism

REFER ALSO TO CITATION(S) 14154, 14204, 14477, 14478, 14480, 14528, 16030, 16135, 16156

16028 **(CONF-8811145—1) Cadium-induced bone loss: Effects in ovariectomized mice and osteoclast-like cells in culture.** Bhattacharyya, M.H.; Seed, T.M.; Peterson, D.P.; Moretti, E.S.; Kuhn, C.; Brice, L.F.; Choi, T.T. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004264/JAW.

From U.S. Department of Energy/Office of Health and Environmental Research contractors meeting on chemical toxicology; Albuquerque, NM, USA (17 Nov 1988).

The research reported here was conducted to investigate the possibility that cadmium might be a factor that increases bone loss after the menopause. In our first study, we exposed female CF1 mice to a purified diet containing $CdCl_2$ at either 0.25, 5.0, or 50 ppM Cd starting at 70 days of age. After 12 months of exposure, mice were ovariectomized (OV) or sham-operated (SO). After surgery, they remained on their respective diets for an additional six months before sacrifice. Results showed that neither ovariectomy alone nor dietary Cd exposure alone significantly decrease bone calcium content. However, dietary Cd at 50 ppM in combination with ovariectomy caused a striking decrease in the calcium content of mouse bones. The mice in the above study were quite old (435 days old at ovariectomy; 617 days old at sacrifice) and had been exposed to dietary cadmium for one year prior to removal of the ovaries. Consequently, the follow-up study reported here was conducted in mice whose skeletons were pre-labelled with ^{45}Ca. This study was designed to determine whether cadmium exposure would cause as increased release of ^{45}Ca from the skeletons of OV mice immediately after the start of cadmium exposure and in the absence of the one-year pre-exposure period present in our first study. Such results would indicate that cadmium might act directly on bone rather than indirectly by way of damage to another organ such as the kidney. 14 refs., 1 fig.

5506 Medicine

REFER ALSO TO CITATION(S) 14466, 15594, 15657, 15859, 15859, 15860, 15862, 15905, 16069, 16412, 16412

16029 **(AD-A—200647/6/XAB) Magnetic resonance imaging and contrast enhancement. Scientific report.** Swenberg, C.E.; Movius, E.G. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1988. 58p. (AFRRI-SR—88-19). NTIS, PC A04/MF A01.

Pub. in Imaging Techniques in Biology and Medicine, 391-357(1988).

Chapters II through VI of this report discuss: Relaxation of Nuclear Spins; Echo Techniques; Basic Imaging Pulse Sequences; Partial Saturation Recovery; Inversion Recovery; Spin Echo; Effects of Pulse Sequence on Image Contrast; Contrast Agents; Theo-

retical Aspects; Pharmacokinetics and Toxicity; and Physiological Rationale for Agent Selection. One of the major goals in all medical imaging techniques is to maximize one's ability to visualize and differentiate adjacent tissue regions in the body on the basis of differences in anatomy, physiology, or various pathological processes. Magnetic resonance (MR) imaging offers distinct advantages over conventional x-ray imaging because of the possibility of selecting specific pulse sequences that can differentiate adjacent structures on the basis of differences in proton density, T_1 or T_2 relaxation rates, or flow. As a result of applying these various pulse sequences, numerous images have been obtained of the brain and other organs that demonstrate considerably more-detailed anatomical structure than had previously been available with computerized tomography, ultrasound, or nuclear medicine techniques. In some situations it is clearly superior, such as in the diagnosis of multiple sclerosis.

16030 **(DOE/ER/60487—3) Development of more efficacious Tc-99m organ imaging agents for use in nuclear medicine by analytical characterization of radiopharmaceutical mixtures: Progress report, September 1, 1986--August 31, 1989.** Heineman, W.R. (Cincinnati Univ., OH (USA). Dept. of Chemistry). Feb 1989. Contract FG02-86ER60487. 37p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006819/JAW.

The long-range objective of this research program is the development of more efficacious technetium-99m radiopharmaceuticals for use as imaging agents in diagnostic nuclear medicine. Within this overall goal, we seek to isolate and develop distinct site imaging agents, each of which has properties optimized to provide diagnostic information concerning a given pathological condition. These objectives are being accomplished by the development of analytical techniques which are capable of separating clinically used radiopharmaceutical mixtures into their component technetium complexes, which can then be characterized in pure form by techniques such as EXAFS and mass spectrometry. The relative imaging efficacies of the individual technetium complexes have been evaluated in animal models to determine if individual components have different in vivo distributions. Techniques are being developed whereby the most efficacious complexes can be prepared rapidly in high yield. Administration of the isolated, single most effective imaging complex, rather than a mixture of technetium-containing complexes (as is the current clinical practice), will minimize radiation exposure to the patient and maximize diagnostic information available to the clinician. 102 refs.

16031 **(DOE/FTR—9006025) [Society of Nuclear Medicine meeting, Toronto, Canada, May 30--June 6, 1987]: Foreign trip report.** Wolf, A.P.; Fowler, J.S.; Redvanly, C.; Schlyer, D.; Shiue, Chyng Yann; Dewey, S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006025/JAW.

The Society of Nuclear Medicine (US) annual meeting was held in Toronto, Canada, May 31--June 5. This is a scientific meeting with papers encompassing the field of Nuclear Medicine held in multi- session format and is identical with meetings normally held in the US. Comment on any specific aspect can be provided if requested, or abstracts of each paper attended can be provided.

16032 **(EGG-M—88075) Computerized axial tomographic and magnetic resonance imaging scan follow-up of two patients after boron neutron capture therapy for Glioblastoma Multiforme.** Marano, S.R.; Spickard, J.H.; Griebenow, M.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 14p. (CONF-8805150—5). NTIS, PC A03 - OSTI. Order Number DE89005425/JAW.

From 4. international conference on neutron capture therapy; Bremen, F.R. Germany (31 May 1988).

Using computer tomography (CT) and magnetic resonance imaging (MRI), we are following a 30-year old, white female and a 64-year old, white female and a 64-year old, white male, both with biopsy-proven Glioblastoma Multiforme, from their preoperative through post-operative stages and pre- and post-BNCT treatment. The images visually demonstrate the evolving changes in the tumor and surrounding cortex. These patients were treated by Hiroshi Hatanaka of Teikyo University, at the Musashi Institute of Technology (MIT) reactor which is a 100 kW Triga-II facility that has been used by Hatanaka for many years for BNCT therapy. 10 figs.

16033 **(EGG-M—88187) Analysis of boron containing biological samples by ICP.** Bauer, W.F.; Johnson, D.A.; Messick, K.M.; Miller, D.L.; Propp, W.A.; Steele, S.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 9p. (CONF-8808189—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005278/JAW.

From NCI BNCT boron compound conference; Annapolis, MD, USA (3 Aug 1988).

An important aspect of boron neutron capture therapy (BNCT) is the determination of the biological distribution of the boron within an organism at some point in time after administration of a boron- containing species. Techniques include prompt gamma analysis, colorimetric techniques, and most recently, inductively coupled plasma atomic emission spectroscopy (ICP-AES) techniques. In this paper, an ICP technique was used to determine the boron content in tissue and various biological fluid samples obtained from dogs have spontaneously-occurring brain tumors and to which had been administered the sodium salt of the sulfhydryl borane ($B_{12}H_{11}SH$)/sup 2{minus}/. The spontaneous error model allowed tissue to be collected that had the same relative kinetics and disruptions of the blood brain barrier as found in human brain cancer. Many of these subjects also had peritumor edematous tissue that did not have a visibly detected alteration in the blood brain barrier. The large size of the dog allowed tissues to be collected for analysis that may be affected during irradiation.

16034 **(GSI—88-60-Prepr.) GSI project: Biomedical and radiobiological activities at GSI.** Kraft, G.; Angert, N.; Blasche, K.; Fischer, B.; Geissel, H.; Klabunde, J.; Langenbeck, B.; Muenzenberg, G.; Schardt, D.; Schwab, T. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Heidelberg Univ. (Germany, F.R.). Strahlenklinik; Deutsches Krebsforschungszentrum, Heidelberg (Germany, F.R.)). Nov 1988. 17p. (CONF-8811152—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756613/JAW.

From EULIMA workshop on the potential value of light ion beam therapy; Nice, France (3 Nov 1988).

At GSI a heavy synchrotron (SIS) is under construction which enables the acceleration of all heavy ions from helium to uranium to energies of at least 1 GeV/u and having intensities of 10/sup 9/ particles/sec. The use of this heavy ion synchrotron for radiotherapy is proposed in addition to the program of physics experiments. Short beam periods of about 5 min/hour are sufficient to run an experimental therapy program. The total costs of this program are in the order of 17 Million DM for the first 5 years which is in the same order as the costs for a conventional high energy physics experiment and much cheaper than any dedicated medical accelerator. However, it is very clear at this time that the use of such a complex of accelerators is too expensive for installation at a normal radiotherapy clinic. But a break-through in heavy ion therapy which can be achieved by the presently available machines will stimulate the development of less expensive machines, as it is proposed in the EULIMA project.

16035 (IA—1440, pp 214-215) **Radiation dosimetry of / sup 191/Os//sup 191m/Ir generator eluate.** Schlesinger, T.; Weininger, J.; Trumper, J.; Issachar, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16036 (IA—1440, pp 213-214) **Preliminary clinical studies using a /sup 191/Os//sup 191m/Ir generator for blood perfusion in kidney and brain.** Issachar, D.; Zemach, D.; Trumper, J.; Lubin, E.; Zafrir, N.; Liberman, L.; Baron, J. (Israel Atomic Energy Commission, Tel Aviv; Beilinson Hospital, Petah Tiqva (Israel). Dept. of Nuclear Medicine; Sheba Medical Center, Tel Hashomer (Israel). Dept. of Radiotherapy and Isotopes; Ichilov Hospital, Tel Aviv (Israel)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16037 (INIS-mf—11348, pp 27) **Use of /sup 125/I-T3 in serum triiodothyronine uptake test.** Lavalley, C.; Ferro, F.; Zambrano, F.; Lezama C, J.; Delgado, B. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16038 (INIS-mf—11348, pp 19) **Labelling and evaluation of (99mTc-atrioube).** Arteaga de Murphy, C.; Vidal N, A.; Coo L, J.; Ruiz J, A.; Contreras, Ma. de los A. (Instituto Nacional de Nutricion Salvador Zubiran, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16039 (INIS-mf—11351, pp 116-119) **Computer-aided decision-making for early detection of breast cancers using fuzzy classification.** Schueller, W. (Bezirkskrankenhaus, Karl-Marx-Stadt (German Democratic Republic)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The experts system DIDIMA was developed for timely detection of the early stage of breast cancer in women using the HEWLETT-PACKARD 9845 B computer in the BASIC programming language. The expert system is based on the theory of fuzzy sets. The parameters and structure of the fuzzy knowledge base is given. The system was introduced into practice and its possibilities are described for diagnosis and therapy. (E.S.).

16040 **(INIS-mf—11351) Topics in clinical oncology. 14.** Cepcek, P. (ed.). (Ustav Klinickej Onkologie, Bratislava (Czechoslovakia)). Aug 1987. 196p. (In English, Czech, Slovak). (CONF-8609339—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW.

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The symposium proceedings contain 39 papers. All papers were inputted in INIS. The subjects of the papers were the use of computers in radiotherapy planning, and clinical dosimetry, equipment and quality assurance, biological radiation effects and radiation protection problems in radiotherapy. (J.P.).

16041 (INIS-mf—11351, pp 7-10) **Influence of patient size and shape on absolute CT numbers for four different scanner systems.** Jessen, K.A.; Joergensen, J. (Kommunehospitalet, Aarhus (Denmark)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Four most frequently used CT systems (EMI 7070, GE 8800, Tomoscan by Philips and Somatom DRH by Siemens) were compared in a study into the possible quantitative use of absolute CT numbers in the aorta, the spleen and the liver. The patient's position in the gantry, his or her size were found to significantly affect the CT numbers and their quantitative use. Important variations were also found between the systems under study. It thus appears that quantitative CT scanning for diagnostic purposes is questionable and must always be performed under controlled conditions taking into consideration also the machine parameters, such as noise and spatial resolution that are not normally disclosed by the manufacturers. (L.O.). 4 figs., 5 tabs.

16042 (INIS-mf—11351, pp 11-12) **CT-based tratment planning system for Commodore-64 home computer.** Treer, T. (Department of Radiology, Medical University, Pecs (Hungary)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Software is briefly described written for Commodore-64 home computer for the computation and drawing of isodose curves in static field dose planning. It allows selecting the optimal dose plan from alternative dose distributions by not only computing the volume dose absorbed by the tumor and the healthy tissues but also evaluating the effective volume dose after Wendhausen, thus indicating a dose plan involving the lowest radiobiological risk for the patient. The use of the said computer and the software was shown to be sufficiently accurate and quite inexpensive. (L.O.). 4 figs.

16043 (INIS-mf—11351, pp 12-15) **Topometry and dose planning in telegammatherapy of the prostatic carcinoma.** Miltchev, V.; Alexandrova, L.; Moushmov, M. (Nauchno-Izsledovatelski Onkologichen Inst., Sofia (Bulgaria)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A computer-aided technique is described of planning and irradiation for radical radiotherapy of local and local-regional stages of prostatic carcinoma. The technique provides a homogeneous dose distribution in the target volume and a considerable dose reduction in the high-risk organs, i.e., the rectum and the bladder. The optimal dose distribution is achieved by the arc of rotation from 240deg to 300deg. The field size varies between 7 and 10 cm. The isocentre is found for each patient individually according to his anatomical characteristics and the proliferation of the tumorous process. Thus, the dose for the dorsal wall of the rectum and the ventral part of the bladder is only 50 to 80% and for the femur neck below 50% of the tumor dose. Using the technique described, irradiation is easy and the accuracy of dose distributions meets the demands of radiotherapy. (L.O.). 3 figs., 5 refs.

16044 (INIS-mf—11351, pp 15-18) **Computer program for physical and radiobiological calculations of the treatment plans in complex radiotherapy of carcinomas of the uterine cervix.** Matula, P.; Futas, E.; Rexova, J.; Briznakova, M.; Klvana, M.; Kazar, A. Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A description is given of calculation procedures and of computer codes for the establishment of physical and radiobiological values of treatment plans in radiotherapy of the uterine cervix carcinoma. It is emphasized that planning in the radiotherapy of uterine malignancies must be individualized using three-dimensional distribution calculations; dose planning is insufficient without calculating composite isodose plans from indo- and external beam therapy; isoeffect distribution calculations offer a deeper insight into radiobiological effects of radiotherapy. (L.O.). 5 figs., 5 refs.

16045 (INIS-mf—11351, pp 19-26) **Pencil beams model for radiotherapy planning.** Mach, J.; Potmesil, J. (Krajsky Ustav Narodniho Zdravi, Plzen (Czechoslovakia). Fakultni Nemocnice s Poliklinikou). Aug 1987. (In Czech). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A semi-empirical model is described in detail of pencil beams for use in radiotherapy. It is shown to be suitable for computer-

aided planning of irradiation, mainly thanks to its accuracy and flexibility. (L.O.). 8 figs., 1 tab., 8 refs.

16046 (INIS-mf—11351, pp 26-28) **Program for radiotherapy treatment planning.** Potmesil, J.; Mach, J. (Krajsky Ustav Narodniho Zdravi, Plzen (Czechoslovakia). Fakultni Nemocnice s Poliklinikou). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

An original pencil beam model for the calculation of an isodose plan is characterized and its benefits are outlined. The model was described in detail elsewhere. Software and hardware employed are then discussed in more detail, using a model, for dose calculations taking into account tissue inhomogeneities, field irregularities, etc. The system called ONPLAN allows accurate calculations of isodose plans to be made for various irradiation techniques, this both in the transversal plane and in the parallel plane, i.e., a quasi-3 D planning. (L.O.). 3 refs.

16047 (INIS-mf—11351, pp 29-30) **Optimization of radiotherapy in Ca mammae.** Rasovska, O.; Malir, A.; Krystof, V.; Kudlickova, Z.; Pecina, J. Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The EVADOS radiotherapy planning system is briefly described, used to individualize standard irradiation techniques and to accurately determine the dose distribution in the irradiated volume. The system calculates the values from CT scans of the individual patients. Satisfactory therapeutical effects can thus be achieved while assuring the highest possible radiation protection level. (L.O.). 3 figs.

16048 (INIS-mf—11351, pp 31-32) **Our experiences with brachytherapy treatment planning.** Plesko, B.; Laginova, V.; Kallay, J.; Keder, D.; Kralik, G. (Ustav Klinickej Onkologie, Bratislava (Czechoslovakia)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Experience is described with the application of the /sup 137/Cs Low Dose Rate SELECTRON afterloading system in the management of uterine cervix carcinoma patients. Data for accurate low dose therapy planning, such as the position of applicators, sources and specified points related to the organs at risk are derived from orthogonal X-ray projections. The Philips OSS treatment planning system using the Meisberger-Shalek model is used for dose distribution calculations. The calculations are verified for all patients by in vivo dosimetry of the rectum and the bladder. (L.O.). 1 tab.

16049 (INIS-mf—11351, pp 33-36) **Complex dose planning on IBM compatible PC.** Katona, E.; Polgar, I.; Zarand, P. (Weil Emil Korhaz-Rendeloeintezet, Budapest (Hungary). Foevarosi Onkoradiologiai Koezpont). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A comprehensive irradiation treatment planning program was developed. The program is adequate for the calculation of the dose distribution of both external and internal irradiations as well as for the simulation of the reproducibility of the treatment plan at points or lines of interest. It allows the fiting and the statistical evaluation of the patients' and treatment data. A brief description of an IBM compatible program and a comparison of the calculated and measured dose distributions are presented. An example is given of quality assurance of radiation treatment. (author). 8 figs., 11 refs.

16050 (INIS-mf—11351, pp 52-53) **Comparison of isodose charts for cobalt-60 teletherapy unit "Rocus".** Panchev, V.; Constantinov, B.; Ivanova, K. (Meditsinska Akademiya, Sofia (Bulgaria). Katedra po Rentgenologiya i Radiologiya). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A comparison was made of the accuracy of isodose charts for /sup 60/Co Rocus teletherapy units in Bulgaria. Compared were charts supplied by the manufacturer in an atlas from 1968 for the source-surface distance (SSD) of 60 cm, isodose charts for SSD 60 cm and 75 cm, respectively, provided by the Oncological Institute, Leningrad (SU), and charts for both SSD values plotted by the Laboratory using RFA-3-50 and VA-K-251 instruments. The comparison showed that the SSD 75 cm isodose charts used so far were sufficiently accurate and their use may continue. On the other hand, the SSD 60 charts plotted by the Laboratory showed that the single beam dose distribution values for the Rocus units were better than those in the Atlas. The dose gradient in the penumbra region was steeper, the isodose plateaux were flatter, and in the regions important for radiotherapy, isodoses were at greater depths. (L.O.).

16051 (INIS-mf—11351, pp 53-60) **Determination of photon output factors for /sup 60/Co machines.** Tobola, K.; Hambalek, P.; Novotny, J.; Kovar, I.; Wagner, R.; Jirousek, P. (Krajsky Ustav Narodniho Zdravi, Ostrava (Czechoslovakia); Ceskoslovenska Akademie Ved, Prague. Ustav Dozimetrie Zareni). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A semi-empirical model is described for obtaining parameters that can be fitted to experimental data for cobalt radiotherapy units with the minimum of measurements. They include beam configuration parameters, such as the collimator set-up data using the source-diaphragm distance values (SDD) and the source-surface distance values (SSD), the exposure output factor dependence on SSD and on the collimator angle, the dose factor dependence on the collimator angle, and a general formula for absorbed dose calculations. The model is simple and its use improves quality assurance in radiotherapy. For the calculation, a hand-held calculator can be used in view of the small number of parameters involved. (L.O.). 4 refs.

16052 (INIS-mf—11351, pp 60-66) **Dosimetry in teletherapy in Cracow.** Szymczyk, W.; Lesiak, J.; Polok, B.; Polak, B. (Instytut Onkologii, Krakow (Poland)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A dosimetry procedure is described used as standard by the Institute, based on the use of an automated water phantom system for beam data acquisition and a dedicated minicomputer system for individualized treatment planning. An approach is also characterized to fractionated radiotherapy based on the time-dose and fractionation (TDF) concept introduced by Goitein. The program for iso-TDF distribution assessment considers both electron beam and /sup 60/Co radiation parameters. An example is shown of the application of the program in abdomen treatment using the moving strip technique. Some constraints are outlined of routine practice. (L.O.). 10 figs., 2 tabs., 13 refs.

16053 (INIS-mf—11351, pp 67-72) **Comparison of theoretical and experimental dose distributions generated by therapeutic electron beams.** Hlavacova, I.; Tobola, K.; Spackova, D. (Krajsky Ustav Narodniho Zdravi, Ostrava (Czechoslovakia)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Spatial distributions of the absorbed dose of therapeutical electron beams generated by a Siemens 500A betatron were measured using an original water phantom controlled with an EMG 666

calculator. Readouts of the two channel ionmetric systems were evaluated and transferred to a floppy disk. The experimental data were compared with Hogstrom's and Kawachi's models. While our attempt to adapt Kawachi's free parameters to the experimental distributions failed, quite good agreement was achieved when comparing experimental profiles and those calculated using the pencil beam model of Hogstrom. Without any experimental weighting factor the agreement is closely related to the degree of homogeneity of the beam. The effect of homogenizing scattering foils on the initial scattering angle is discussed as is the possibility of central beam depth dose calculation. (author). 2 figs., 2 tabs., 9 refs.

16054 (INIS-mf—11351, pp 105-109) **CART - a Scandinavian approach to computer aided radiation therapy.** Walstam, R. (Stockholm Univ. (Sweden). Dept. of Radiation Physics). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The CART project, a program of computer-aided radiation therapy developed as a joint venture by Scandinavian countries is described. The history is outlined and the individual areas of the CART program are listed. (L.O.). 3 refs.

16055 (INIS-mf—11351, pp 140-144) **Quality assurance in radiation therapy: ionization chamber calibration and intercomparison of absorbed doses.** Laginova, V.; Plesko, B.; Novotny, J.; Kovar, I.; Jirousek, P.; Wagner, R. (Ustav Klinickej Onkologie, Bratislava (Czechoslovakia); Ceskoslovenska Akademie Ved, Prague. Ustav Dozimetrie Zareni). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A secondary standard for calibration of ionization chambers used in radiotherapy was established by the Institute of Clinical Oncology in Bratislava in 1984. The secondary standard consists of / sup 60/Co treatment unit Chisobalt, a Baldwin-Farmer dosemeter and a Baldwin ionization chamber. The exposure and kerma rates of the primary dosimetry standard which is regularly checked are used. The parameters, uncertainties and stability of the secondary standard are discussed. A comparison of absorbed doses from /sup 60/Co gamma rays of therapy units in water phantom was performed for all radiotherapy centers in Czechoslovakia. The results showed that all observed doses were within +-3% from the absorbed dose specified. (author). 2 figs., 4 tabs., 8 refs.

16056 (INIS-mf—11351, pp 146-152) **Proton therapy complex with three procedure rooms.** Chuvilo, I.V.; Goldin, L.L.; Khoroshkov, V.S. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

An oncological research and treatment complex is described in detail where radiotherapy management uses proton beams. The whole irradiation plant is provided with three procedure rooms, viz., for intracranial irradiation, for chest, neck and head irradiation and for uro-gynecological applications. The proton beam is extracted from an accelerator as short pulses of about 100 ns in duration at a repetition frequency of 0.3 Hz. Beam intensity is 10/sup 10/ to 10/sup 11/ particles per pulse. Only about 8% of particles accelerated up to the necessary energy are used for medical purposes. The rest is accelerated on for use in heavy particle physics experiments. Data on patients and clinical results are summarized. (L.O.). 4 figs., 3 tabs., 10 refs.

16057 (INIS-mf—11351, pp 153-161) **Special topometric and dosimetric features of different proton irradiation techniques.** Khoroshkov, V.S.; Belyaikin, E.V.; Breev, V.M.; Kostyuchenko, V.I.; Lisovets, S.P.; Lomanov, M.F.; Pokhvata, V.P.; Shimchuk, G.G.; Krymskij, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki; Akademiya Meditsinskikh Nauk SSSR, Moscow. Nauchno-Issledovatel'skij Inst. Nejrokhirurgii). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

The criteria are discussed for the choice of proton beam irradiation techniques and the two main techniques, i.e., radiographic and beam stop techniques are described. The topometric and dosimetric considerations are presented and dose field deformations are estimated due to topometric uncertainties. A dose planning method is proposed minimizing the adverse effects of topometric errors. (L.O.). 10 figs., 6 refs.

16058 (INIS-mf—11351, pp 188-190) **Cumulative effect in fractionation and the choice of radiotherapeutical treatment schemes.** Prokes, K.; Lokajicek, M.; Judas, L. Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A semiphenomenological model is described for the calculation of survival following a fractionation course in radiotherapy. The model is based on the generalization of the NSD concept. It allows increasing the efficacy of radiotherapy by more flexible distribution of fractions, i.e., several fractions in weekly intervals rather than the common scheme of 5 fractions per week. (L.O.).

16059 (INIS-mf—11351, pp 190-193) **Method for radiation treatment of malignant nasopharyngeal tumors and results of its application on 228 patients.** Pandova, V.; Ganchev, M.; Naumova, Z.; Miltchev, V. (Meditsinska Akademiya, Sofia (Bulgaria)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Experience is described with radiotherapy of nasopharyngeal tumors and techniques are discussed resulting in dose reduction. The efficacy and accuracy of dose planning procedures are illustrated graphically and with figures showing survival rates and the incidence of complications that is considered acceptable. (L.O.). 6 figs., 7 refs.

16060 (INIS-mf—11351, pp 109-116) **Conservative treatment of breast carcinoma with interstitial boost dose.** Loeffler, E. (Wuerzburg Univ. (Germany, F.R.). Frauenklinik). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A procedure is described of radiotherapy management of breast cancer using a remote control afterloading system with /sup 192/I implants combined with fractionated external irradiation. Thus, typical management of early breast cancer consists in surgery followed by a boost dose of about 20 Gy of /sup 192/I into the tumor bed and additional external beam therapy with 45 Gy in 2 Gy weekly fractions. Where necessary, chemotherapy follows after the completion of radiotherapy. The implant technique, treatment planning, source preparation and initial dosimetry are described and the specifications are given of the MicroSelectron afterloading machine from Nucletron, Holland. The calculation is explained of dose rate corrections allowing re-use of the iridium source assemblies. This also requires the application of isocentric stereo reconstructions of the implants for individualized treatment planning. The procedure is also described. (L.O.). 9 figs., 1 tab., 15 refs.

16061 (INIS-mf—11351, pp 144-146) **Irradiation plant for gamma-neutron brachytherapy using californium-252 radionuclide at VUKEO Brno.** Krystof, V.; Tacev, T.; Ott, O. (Vyzkumny Ustav Klinicke a Experimentalni Onkologie, Brno (Czechoslovakia)). Aug 1987. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A specialized treatment room was built at VUKEO (Research Institute of Clinical and Experimental Oncology) Brno using /sup 252/Cf sources of Soviet made for intracavitary applications to especially treat gynecological tumors. Parts of the treatment room are protected with a patent claimed by the Chirana Research Institute of Health Technology. The workplace includes facilities for safekeeping and handling the sources and for personnel protection from gamma-neutron /sup 252/Cf radiation. 1 fig.

16062 (INIS-mf—11354) **14. Congress of the Hungarian radiologists. Abstracts.** Soos, Jozsef (Magyar Nephadsereg Koezponti Korhaza, Budapest (Hungary)) (ed.). (Magyar Orvostudomanyi Tarsasagok es Egyesueletek Szoevetsege, Budapest. Magyar Radiologus Tarsasag). 1988. 301p. (CONF-8808195—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88705530/JAW.

From 14. Congress of the Hungarian radiologists; Budapest, Hungary (24 Aug 1988).

At the conference 250 papers were presented in various fields of medical radiology. After the plenary session, the subjects of the separate topical sessions were radiological applications in neuro-traumatology, pathological bone fractures, injuries of blood vessels, ARDS, injuries of thorax, abdomen and pelvis, pediatric traumatology, injuries of bones and joints, and radiotherapy of metastases. The abstracts of the individual papers presented are contained in the conference publication. (R.P.).

16063 (INIS-mf—11895) **Behaviour of venous flow rates in intermittent sequential pneumatic compression of the legs using different compression strengths. Clinical study of 25 patients with the radioisotope method.** Fassmann-Glaser, I. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 1 Oct 1984. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756809/JAW.

A study with 25 patients was performed in order to find out whether intermittent, sequential, pneumatic leg compression is of value in the preventive management of thrombosis due to its effect on the venous flow rates. For this purpose, xenon 133 was injected into one of the foot veins and the flow rate in each case determined for the distance between instep and inguen using different compression strengths, with pressure being exerted on the ankle, calf and thigh. Increased flow rates were already measured at an average pressure value of 34.5 mmHg, while the maximum effect was achieved by exerting a pressure of 92.5 mmHg, which increased the flow rate by 366% as compared to the baseline value. The results point to a significant improvement of the venous flow rates due to intermittent, sequential, pneumatic leg compression and thus provide evidence to prove the value of this method in the prevention of hemostasis and thrombosis. (TRV).

16064 (IPEN-PUB—196) **Development and clinical application of human gastrin radioimmunoassay.** Ginabreda, M.G.P.; Borghi, V.C.; Bettarello, A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 17p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705544/JAW.

The determination of human gastrin levels in the blood is very important for diagnosis of gastrointestinal disorders. This work describes the radioimmunoassay of gastrin developed according to Russell et al. and its clinical application measuring fasting levels of this hormone in normal subjects, gastrectomized, chagasics, patients with chronic renal failure (CRF), pernicious anemia (PA) and Zollinger-Ellison syndrome (ZES). Synthetic human gastrin was used for radioiodination and as standard, while the specific antibody was raised in rabbits. Gastrin was radioiodinated by a modification of the chloramine T technique and purified by anion exchange chromatography in QAE-Sephadex A-25 to a specific activity around 200 uCi/ug. The assays were performed by incubation of /sup 125/I-gastrin, standard gastrin (zero to 500 pmol/l) or unknown samples with the antiserum for 4 days at 4/sup 0/C. The antibody bound and free /sup 125/ I-gastrin was separated by adsorption of the latter to the charcoal. The basal gastrin values of normal subjects ranged from 2 to 74 pmol/l, being these levels higher in the chagasics (from 6 to 261 pmol/l). Higher levels of gastrin were determined in patients with CRF (from 12 to 350 pmol/l), PA (from 160 to 680 pmol/l) and with ZES(1010 pmol/l), while very low levels were confirmed in gastrectomized (from 1 to 8 pmol/l).

16065 (LA-UR—88-4290) **Modeling of laser ablation and fragmentation of human calculi.** Gitomer, S.; Jones, R.D.; Howsare, C. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 7p. (CONF-890158—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005470/JAW.

From SPIE symposium on medical applications of lasers and optics; Los Angeles, CA, USA (15 Jan 1989).

The large-scale radiation-hydrodynamics computer code LASNEX, has been used to model experimental results in the laser ablation and fragmentation of renal and biliary calculi. Recent experiments have demonstrated laser ablation and fragmentation of human calculi in vitro and in vivo. In the interaction, laser light incident upon the calculus is of sufficient intensity to produce a plasma (a hot ionized gas). The physical picture which emerges is as follows. The plasma couples to acoustic and shear waves which then propagate through the dense stone material, causing spall and fracture by reflection from material discontinuities or boundaries. Experiments have thus far yielded data on the interaction against which models can be tested. Data on the following have been published: (1) light emission, (2) absorption and emission spectra, (3) fragmentation efficiency, (4) cavitation bubble dynamics and (5) mass removal. We have performed one dimensional simulations of the laser-matter interaction to elucidate the important physical mechanisms. We find that good quantitative fits between simulation and experiment are obtained for visible light emission, electron temperature, electron density, plasma pressure and cavitation bubble growth. With regard to mass removal, experiment and simulation are consistent with each other and give an excellent estimate of the ablation threshold. The modeling indicates that a very small ablation layer at the surface of the calculus is responsible for significant mass loss by fragmentation within the bulk of the calculus. With such quantitative fits in hand, we believe this type of modeling can now be applied to the study of other procedures involving plasma formation of interest to the medical community. 25 refs., 7 figs.

16066 (LBL—26308) **Compensation for crystal penetration in high resolution positron tomography.** Huesman, R.H.; Salmeron, E.M.; Baker, J.R. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 10p. (CONF-881103—34). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006660/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

We have characterized the effects of crystal penetration by annihilation photons in circular ring positron tomographs. They are most serious in high resolution instruments having small detectors. When annihilation photons are not normally incident and penetrate some distance into the scintillator before interacting, the measurement of their transverse position becomes uncertain. This penetration of photons into the detector material before interaction is a statistical process which leads to significant displacement and anisotropy of the point spread function. The subject of this work is mathematical correction of emission datasets by performing a two-dimensional spatially variant deconvolution of the emission data in sinogram format. Examples for the Donner 600-Crystal Positron Tomograph are presented, and the amplification of statistical errors resulting from the correction procedure is also discussed. 7 refs., 9 figs., 2 tabs.

16067 (PB—88-162805, pp 132-168) **Application of human gene mapping for the global control of genetic disease.** Weatherall, D.J. Feb 1988. NTIS, PC A10/MF A01 - OSTI. Order Number TI88010822/JAW.

In Mapping our genes: Federal genome projects: How vast? How fast? Contractor reports, Volume 2.

One of the major reasons for mapping and ultimately sequencing the human genome is the control of genetic disease in man. In assessing the importance of this project in this context it is important to consider how information derived from the knowledge of the sequence of the human genome might be applied globally for the management of genetic diseases. Because the first disorders of this type to be characterized at the molecular level, the hemoglobinopathies, are the commonest genetic diseases in the world population, and because programs for their control have been initiated in parts of the developing world, it is already possible to define some of the problems that will arise in applying knowledge gained from a genome sequencing program to the improvement of the health of populations in which genetic diseases are particularly common. Here I outline what is known about the world distribution of single gene disorders and about the genetic component of important polygenic conditions in the developed and developing countries, and consider briefly the organizational difficulties that may be encountered in applying this new information to programs for the prevention, and ultimately the treatment, of genetic disease. 34 refs., 2 figs., 2 tabs. (DT)

16068 **Radiolabeled dimethyl branched long chain fatty acid for heart imaging.** Knapp, F.F. Jr.; Goodman, M.M.; Kirsch, G. (to Dept. of Energy, Washington, DC). US Patent 4,764,358. 16 Aug 1988. Filed date 30 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a radiolabeled long chain fatty acid for heart imaging that has dimentyl branching at one of the carbons of the chain which inhibits the extent to which oxidation can occur. The closer to the carboxyl the branching is positioned, the more limited the oxidation, thereby resulting in prolonged retention of the radiolabeled compound in the heart.

5507 Microbiology

REFER ALSO TO CITATION(S) 14204, 14486, 14652, 16018

16069 **(CONF-880787—3) Fully deuterated microorganisms: Tools in magnetic resonance and neutron scattering.** Crespi, H.L. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005827/JAW.

From 3. international symposium on the synthesis and applications of isotopically labeled compounds; Innsbruck, Austria (17 Jul 1988).

Current work at Argonne emphasizes the use of fully deuterated algae and cyanobacteria as tools in the study of photosynthesis and as a source of complex substrates for the culture of engineered overproducing bacteria. 17 refs., 1 fig., 1 tab.

5509 Pathology

REFER ALSO TO CITATION(S) 16151

5510 Physiological Systems

REFER ALSO TO CITATION(S) 16028, 16143

16070 **A computational model of the auditory system.** Travis, B.J. (Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the IEEE first international conference on neural networks. Volumes 1-4. Caudill, M.; Butler, C. Piscataway, NJ; IEEE Service Center (1987). (CONF-8706130—).

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

The goal of the project described in this paper is to build a biologically valid model of a sensory system, which integrates what is known both structurally and physiologically at several levels, from the peripheral sense organ to the midbrain nuclei to the cortex. Despite the complexity of these systems, there is a great deal of data available at each level to permit a fairly realistic model for some sensory systems (vision, hearing, and olfaction), although simplifications in scale must be made especially at the cortex level to remain within present computer memory and speed limits. Attractive features of such a model are that it: 1) includes more structure (and presumably more processing capacity) than previous models, 2) provides each subsystem with the kind of input that the biological counterpart receives (to understand what the brain is doing requires a clear description of the data it operates on), 3) emphasizes the dynamic or time dimension, especially important for audition, 4) provides a means of testing theories about sensory perception. In the remainder of this article, the structure of the cortex and subcortical nuclei are discussed in the context of a particular sensory system, the auditory. A computational model is presented, and results of an application of the model are shown.

5520 Public Health

REFER ALSO TO CITATION(S) 14317, 14853, 15943, 15952, 15953, 15954, 15955, 15956, 15957, 15958, 15959, 15960, 16005, 16018, 16139, 16152, 16153

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 14511, 14515, 14522, 14523, 14652, 14854, 15980, 15981, 15982, 15983, 15984, 15985, 15986, 15987, 15988, 15989, 15990, 15991, 15992, 16001

16071 **(DOE/ER/13900—1) [Structure and expression of nuclear genes encoding rubisco activase]: Progress report.** (Illinois Univ., Urbana (USA). Dept. of Plant Biology). [1989]. Contract FG02-88ER13900. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006107/JAW.

Our first year's activities include: (1) completing a survey of the basic characteristics of activase gene expression in barley; and (2) isolating and structurally characterizing cDNA and genomic DNA sequences encoding activase from barley. Our goal was to determine whether activase mRNA and protein accumulation are coordinated with those of the rubisco subunits. We utilized the first leaves of barley as an experimental system for these studies because they can be used in two ways to study the expression of leaf genes: by following the naturally occurring differentiation of leaf cells, which occurs acropetally along the barley leaf; and by following the photomorphogenesis of etiolated barley seedlings. In the acropetal gradient of leaf cell differentiation, activase mRNA and mRNA and polypeptide expression is tightly coordinated with rubisco subunit mRNA and polypeptide expression. Although we have not measured their precise stoichiometry at each stage of leaf differentiation, activase protein is expressed at the level of about one polypeptide per rubisco holoenzyme in mature regions of the leaf. Coordination of the expression of activase mRNAs and polypeptides indicates that in the barley leaf gradient, activase gene expression is largely controlled at the level of transcription. However, translational controls may play a role in regulating activase expression on a short term basis.

16072 (IA—1440, pp 257) **Conceptual design for a low-cost versatile small-commercial-scale food-irradiation facility.** Lapidot, M.; Saveanu, S. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16073 (IA—1440, pp 258) **Use of ionizing radiation to eliminate pathogenic bacteria in frozen poultry liver.** Eisenberg, E.; Lapidot, M.; Ross, I.; Saveanu, S.; Klinger, I. (Israel Atomic Energy Commission, Tel Aviv; Kimron Veterinary Institute, Beit Dagan (Israel)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16074 (IA—1440, pp 260-262) **Radiation sterilization of spices and condiments for the food industry.** Lapidot, M.; Ross, I.; Saveanu, S. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16075 **(IPEN-PUB—182) Radioimmunoassay for the determination of low insulin levels.** Toledo e Souza, I.T. de; Wajchenberg, B.L.; Okada, H. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705541/JAW.

The assay system was set up in such a way as to increase the sensitivity of the reaction, reducing the tracer concentration from the usual 1.000 cpm/ml to 500 cpm/ml levels of radioactivity (specific activity aproximately 200 mCi/mg) and/or increasing the antiserum dilution by one thirty of the usual values in the assay of the final volume of incubation of 2,5 ml.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 15842

16076 **(AD-A—200644/3/XAB) Flow cytometric characterization of rat thymus cells in a radiation-dominated model of combined injury. Scientific report.** Kaffenberger, K.; Gruber, D.F.; MacVittie, T.J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1988. 10p. (AFRRI-SR—88-14). NTIS, PC A02/MF A01.

Pub. in Jnl. of Trauma, Vol. 28, No. 5, 593-601(1988).

Thymuses of rats that had been: (a) gamma-irradiated 500 cGy whole-body radiation (R), or (b) thermally injured 20% BSA dorsal, scald burn (TI), or c) combined injured irradiation followed by burn (CI) were studied for involution and recovery processes after sublethal treatments. The expression of surface antigens on thymic cells before and after injuries was evaluated using the monoclonal antibodies and flow cytometric analysis. Thymic cellularity decreased to less than 1% of normal (N), age-matched rats by 4 days after R or CI. Recovery reached 60% to 70% of N by 28 days post treatments. Expression of OX7, OX8, W3/13, and W3/25 antigens all reached nadirs of 40% of N by day 4 after R and CI. Recovery of antigen expression, except for W3/25, was near completion by day 7 after R and CI. Changes in antigen expression after TI were less pronounced for all mcAB tested. Variations in relative labeling of nonlymphoid thymic cells with OX4 (Ia-antigen) reflected the disappearance and recovery of radiosensitive lymphoid thymocytes. The similarity of results after R and CI demonstrate that the model of CI is radiation-dominated. The addition of burn injury to radiation trauma had no synergistically damaging effect on the parameters studied.

16077 **(AD-A—200646/8/XAB) Quantitative, functional, and biochemical alterations in the peritoneal cells of mice exposed to whole-body gamma irradiation. 1. Changes in cellular protein, adherence properties, and enzymatic activities associated with platelet-activating factor formation and inactivation, and arachidonate metabolism. Scientific report.** Steel, L.K.; Hughes, H.N.; Walden, T.L. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1988. 22p. (AFRRI-SR—88-18). NTIS, PC A03/MF A01.

Pub. in International Jnl. of Radiation Biology, Vol. 53, No. 6, 943-964(1988).

Changes in total number, differentials, cell protein, adherence properties, acetyltransferase and acetylhydrolase activities, prostaglandin E2 and leukotriene C4 production, as well as calcium (2+) ionophore A23187 stimulation were examined in resident peritoneal cells isolated from mice 2h to 10 days postexposure to a single dose (7,10 or 12 Gy) of gamma radiation. Radiation dose-related reductions in macrophage and lymphocyte numbers and increases in cellular protein and capacity to adhere to plastic surfaces were evident. In-vitro irradiation also elevated the activities of acetyltransferase and acetylhydrolase (catalyzing platelet-activating factor biosynthesis and inactivation, respectively) in adherent and nonadherent peritoneal cells, particularly 3-4 days postexposure. Blood plasma from irradiated animals did not reflect the increased cellular acetylhydrolase activity. Prostaglandin E2 and leukotriene C4 synthesis were elevated postexposure, suggesting increased substrate (arachidonate) availability and increased cyclooxygenase and lipoxygenase activities. Ionospheric stimulation of enzyme activities and eicosanoid release also differed in irradiated peritoneal cells. While the properties of adherence, platelet-activating factor synthesis/inactivation-associated enzyme activities, and eicosanoid production are generally characterized as those of macrophages, lymphocytes or their products may influence or contribute to the observed radiation-induced changes.

16078 **(CIEMAT—615) Individual monitoring program for internal contamination by inhaled uranium.** Vazquez, C.; Chapel, M.L.; Saenz, R. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1988. 110p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756332/JAW.

The metabolic behaviour of inhaled uranium is studied. using a particular analytical method applied to the models and dose assessment methods recommended by ICRP, The organ committed equivalent dose and effective equivalent dose are calculated. The exact ALI and DAC are derived from there. In the paper, the influence that various parameters have on those results are considered for the specific case of a particular nuclear element fabrication factory. Different AMAD and solubility type of inhaled material are specially analyzed. The results show the paramount importance of some of these parameters on the secondary and derived dose limits. Relationships between the real intake, as a fraction of ALI, and the lung retention or urine excretion are ahown for different cases ands intake forms hypothesis. Minimum dsetectable intakes with the available experimental techniques are then established.

16079 **(CONF-8809137—6) Age, sex and other factors in radiation carcinogenesis.** Fry, R.J.M.; Carnes, B.A. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). 1988. Contract AC05-84OR21400;W-31109-ENG-38. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006135/JAW.

From 14. L. H. Gray conference; Oxford, UK (11 Sep 1988).

It has been held for a long time that the young are more susceptible than adults to the induction of cancer by radiation. The data in support of that contention are accumulating especially from human studies. In an exposed population a significant fraction of the total population risk may be attributed to the risk associated with those who were young at the time of exposure. Since cancer may not appear for decades after exposure estimates of risk may require models for projecting the lifetime risk. Two such models, additive or absolute risk and multiplicative or relative risk have been used. The appropriateness of the latter model is supported by the finding in mice of a positive relationship between natural incidence and the susceptibility for induction by radiation of solid cancer. The choice of model for leukemias is not clear cut. The incidence of cancer increases with age, but the susceptibility for induction decreases. The incidence of cancers increases to a peak and then begins to decline at different ages, dependent on the type of cancer. Sex-dependent differences in both the natural incidence and the susceptibility for induction of cancer are not restricted to sex organs. For example, the susceptibility for the induction by radiation for myeloid leukemia is greater in males than females, whereas in the case of thymic lymphoma it is vice versa. 25 refs., 5 figs., 3 tabs.

16080 **(DOE/ER—0405) Radon Research Program, FY-1988.** (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). Feb 1989. 102p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007284/JAW.

This program summary documents the radon-related research activities supported by the Office of Health and Environmental Research (OHER) during FY-1988. It includes scientific background, research program goals, and summaries in the availability and transport of radon in the environment, and into and

within homes. Also included are summaries of physical-chemical interactions of radon progeny in ambient air and the lung cancer risk to the public from exposure to radon progeny. The main goal is to reduce uncertainties in evaluating health risks to people from inhaling radon and its progeny in indoor air. 113 refs., 15 figs., 2 tabs.

16081 **(EGG-M—88035) Canine spontaneous brain tumors: A large animal model for BNCT.** Gavin, P.R.; Kraft, S.L.; Wendling, L.R.; Miller, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 8p. (CONF-8805150—4). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89005276/JAW.

From 4. international conference on neutron capture therapy; Bremen, F.R. Germany (31 May 1988).

Brain tumors occur spontaneously on dogs with an incidence similar to that in humans. Brain tumors of dogs have histologic, radiologic, and other diagnostic similarities to human brain tumors. Tumor kinetics and biologic behavior of these tumors in dogs are also similar to that in man. Recent studies indicate that conventional radiation therapy of brain tumors of dogs result in a survival interval appropriate to study the late radiation reactions in the surrounding normal brain and other tissues within the irradiated field. The relatively large size of the dog allows identical diagnostic and therapeutic modalities and methodology. The dog's head size enables the complex dosimetric variables to be relevant to that found in human radiation therapy. For these reasons, spontaneous brain tumors in the dog are an excellent model to study neuon capture theory (NCT). 7 refs., 1 fig., 3 tabs.

16082 **(EGG-M—88043) Gross boron determination in biological samples by inductively coupled plasma-atomic emission spectroscopy.** Bauer, W.F.; Johnson, D.A.; Steele, S.M.; Messick, K.; Miller, D.L.; Propp, W.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 8p. (CONF-8805150—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005423/JAW.

From 4. international conference on neutron capture therapy; Bremen, F.R. Germany (31 May 1988).

This paper describes a method for the analysis of boron in biological samples including urine, blood plasma, and tissues with subsequent boron determinations by ICP-AES. A comparison will be made between results obtained by this method and by the prompt-gamma technique on the same samples. 4 refs., 2 figs., 2 tabs.

16083 (IA—1440, pp 271-272) **Adaptive assay of radioactive pulmonary aerosol with an external detector.** Talmor, A.; Laichter, Y.; Ben-Haim, Y.; Kushelevsky, A. (Israel Atomic Energy Commission, Tel Aviv; Technion-Israel Inst. of Tech., Haifa; Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16084 **(INFO—0231-2) Survey of data on the radionuclide content of fish in Canada. A report appendix.** (Atomic Energy Control Board, Ottawa, Ontario (Canada); Beak Consultants Ltd., Toronto, Ontario (Canada)). Jan 1987. 183p. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88705375/JAW.

The appendices of a computerized database of uranium and thorium decay-series radionuclide concentrations in Canadian fish are presented, including concentrations of U-total, Th-total, Th-230, Th-232, Th-228, Ra-226, Po-210 and Pb-210 in various fish tissues. Each record represents a specific tissue from a particular fish sample, indexed by province, lake or river of origin, nearest mine/mill, mine status, distance to mill, sampling date, fish species, tissue type, weight basis of measurement, analytical laboratory, and a number of data quality factors. Additional information includes exact location, UTM cooridnates, sample collector, literature reference, fish weight, length, age and sex, number of fish, and radionuclide concentrations in water and sediment. Records are retrievable by any combination of index variables, radionuclide ranges and/or data quality criteria.

16085 **(INFO—0244) Transfer parameters in the water/forage/moose pathway.** (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Jul 1987. 45p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705376/JAW.

Moose tissue samples and associated water and drinking water samples were collected from the Serpent River Drainage Area (Study Area) and outside of the watershed (Controls) during the fall of 1985. The concentrations of lead-210, polonium-210, radium-226, thorium and uranium were determined for both the study area and control samples. The radionuclide radium-226 was evaluated in the drinking water, vegetation and moose tissue to determine concentration factors. No statistical difference was found between study and control samples. Concentration factors from vegetation to moose tissue were found to range from 0.036 to 3.03 depending upon tissue type. Radionuclide concentrations found in this study were shown to be within known background levels. 2 maps.

16086 (INIS-mf—11348, pp 35) **Radiolysis of alpha-ketoglutaric acid in studies of chemical evolution.** Albarran, G.; Negron M, A.; Perezgasga, L. (Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16087 (INIS-mf—11348, pp 17) **Comparative studies of the effects of gamma radiation on normal rat brain: preliminary experiments on the use of radiosensitizers in brain tumors.** Gonzalez, J.G.; Contreras, M.A.; Camacho, F.M.; Lopez, A.; Moreno, J.; Tovar, V.M. (Instituto Nacional de Cancerologia, Mexico City; Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16088 (INIS-mf—11351, pp 178-187) **Human survival from radiation exposure.** Martin, J.H. (Dundee Univ. (UK)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Answers are sought to three questions, viz.: what levels of several minutes-long whole-body exposure will cause death?, what doses can be accepted for protracted exposure? and what are the long-term consequences of exposure at the levels involved in the cases above? The first involves the problem of defining LD50 which, based on the analysis of theoretical studies and knowledge gained in actual accidents, is set to "not much less than 450 rads bone marrow dose". For determining probability of death from protracted exposure the following two-stage response is quoted expressed in terms of the so-called operational equivalent dose: OED=E-200-15t (surface exposure - R); OED=D-150-10t (bone marrow dose - rads). Delayed effects mostly include cataracts, infertility, malignancies and mortality. It is stated, however, that from a disinterested standpoint, hereditary damage, i.e., following a nuclear war would be tolerable as would be the malignancies because most of the cancers induced would occur when any national reconstruction would be well under way. (L.O.). 9 figs., 5 tabs.

16089 **(INIS-mf—11882) Molecular and cellular mechanisms of biological radiation effects.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). 1988. 140p. (In German, English). (CONF-8803186—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW.

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

The present abstract book contains the abstracts of the 39 lectures and the 70 posters presented at the conference. Separate entries are prepared for 37 of the 39 papers.

16090 (INIS-mf—11882, pp v) **Track structures of charged particles and DNA damage.** Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16091 (INIS-mf—11882, pp v) **Free radicals in irradiated oriented DNA fibers.** Zell, I.; Huettermann, J.; Graeslund, A.; Rupprecht, A.; Koehnlein, W. (Universitaet des Saarlandes, Homburg/Saar (Germany, F.R.). Fachrichtung Biophysik; Stockholm Univ. (Sweden). Dept. of Biophysics and Physical Biochemistry; Muenster Univ. (Germany, F.R.). Inst. fuer Strahlenbiologie). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16092 (INIS-mf—11882, pp v) **Radiation induced cellular resistance to a second irradiation in the thymidine kinase system of mouse bone marrow cells.** Feinendegen, L.E.; Muehlensiepen, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Medizin). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16093 (INIS-mf—11882, pp v) **In vitro and in vivo kinetics of the reactions of the oxygen radical.** Saran, M. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Strahlenbiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16094 (INIS-mf—11882, pp v) **Radiation-induced base release and strand breakage in polynucleotides and DNA.** Sonntag, C. von. (Max-Planck-Institut fuer Strahlenchemie, Muelheim an der Ruhr (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16095 (INIS-mf—11882, pp v) **Protein DNA cross linking due to primary and secondary radicals.** Schuessler, H.; Jung, E.; Goetz, H. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Inst. fuer Radiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16096 (INIS-mf—11882, pp v) **Biological effects and track structure of heavy ions.** Kraft, G.; Kraft-Weyrather, W.; Lang, A.; Ritter, S.; Scholz, M.; Blakely, E.A.; Schmidt, S.; Schmidt-Boecking, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA); Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16097 (INIS-mf—11882, pp v) **Effects of heavy ions on the embryonic development of Carausius morosus in zero-g.** Buecker, H.; Reitz, G.; Horneck, G.; Facius, R.; Graul, E.H.; Ruether, W.; Beaujean, R.; Heinrich, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Koeln (Germany, F.R.). Inst. fuer Flugmedizin; Marburg Univ. (Germany, F.R.). Klinikum; Kiel Univ. (Germany, F.R.). Inst. fuer Kernphysik; Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 7 - Physik). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16098 (INIS-mf—11882, pp v) **Inactivation of Bacillus subtilis spores by accelerated uranium ions: Single studies of spores on AgCl detectors.** Micke, U.; Schott, J.U.; Horneck, G.; Buecker, H.; Mennigmann, H.D. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Koeln (Germany, F.R.). Abt. Biophysik; Frankfurt Univ. (Germany, F.R.). Inst. fuer Mikrobiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16099 (INIS-mf—11882, pp v) **Induction of germ cell mutations by heavy ions in Drosophila melanogaster.** Schaeppi, K.; Schaeppi-Buechi, C.; Fritz-Niggli, H. (Zurich Univ. (Switzerland). Strahlenbiologisches Inst.). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16100 (INIS-mf—11882, pp v) **Production of photoreactivable lesion in the yeast S. cerevisiae by irradiation with 193nm excimer laser light.** Winckler, K.; Golz, B.; Laskowski, W.; Bende, T. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Biophysik und Strahlenbiologie; Klinikum Rudolf Virchow, Berlin (Germany, F.R.). Augen-Poliklinik). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16101 (INIS-mf—11882, pp v) **Biological effects of extraterrestrial solar UV radiation.** Horneck, G.; Buecker, H.; Reitz, G.; Dose, K.; Mennigmann, H.D. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Koeln (Germany, F.R.). Inst. fuer Flugmedizin; Mainz Univ. (Germany, F.R.). Inst. fuer Biochemie; Frankfurt Univ. (Germany, F.R.). Inst. fuer Mikrobiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16102 (INIS-mf—11882, pp v) **Modification of the radiation damage of the SH-enzyme malate synthase by additives.** Durchschlag, H.; Zipper, P. (Regensburg Univ. (Germany, F.R.). Inst. fuer Biophysik und Physikalische Biochemie; Graz Univ. (Austria). Inst. fuer Physikalische Chemie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16103 (INIS-mf—11882, pp v) **Low doses of /sup 137/Cs γ-irradiation stimulate some hormone- and tumour promoter-like reactions in hamster V-79 fibroblasts.** Vicker, M.G. (Bremen Univ. (Germany, F.R.). Fachbereich 2 - Studiengang Biologie). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16104 (INIS-mf—11882, pp v) **Molecular mechanisms of oxidative DNA sugar damage and sequence-dependent mutagenesis by radiomimetic antitumor antibiotics.** Goldberg, I.H. (Harvard Medical School, Boston, MA (USA). Dept. of Biological Chemistry and Molecular Pharmacology). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16105 (INIS-mf—11882, pp v) **Model for the radiation-induced inactivation of cells by DNA damage.** Dikomey, E. (Hamburg Univ. (Germany, F.R.). Inst. fuer Biophysik und Strahlenbiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16106 (INIS-mf—11882, pp v) **Contribution of OH/sup ./ in densely ionizing electron or particle tracks to the induction of DNA double strand breaks.** Frankenberg, D.; Frankenberg-Schwager, M.; Michael, B.; Harbich, R. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Frankfurt am Main (Germany, F.R.). Abt. fuer Biophysikalische Strahlenforschung). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16107 (INIS-mf—11882, pp v) **Study of γ radiation-induced clustered base damage of yeast.** Geigl, E.M.; Eckardt-Schupp, F.; Hagen, U. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Strahlenbiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16108 (INIS-mf—11882, pp v) **Chromosome damage in relation to various responses of mammalian cells to different ionizing radiations.** Barendsen, G.W. (Rijksverdedigingsorganisatie TNO, Rijswijk (Netherlands). Radiobiologisch Inst. TNO; Amsterdam Univ. (Netherlands). Lab. for Radiobiology). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16109 (INIS-mf—11882, pp v) **Statistical analysis of primary lesions and chromosomal aberrations with special regard to the kinetics of repair and misrepair.** Harder, D. (Goettingen Univ. (Germany, F.R.). Inst. fuer Medizinische Physik und Biophysik). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16110 (INIS-mf—11882, pp v) **Chromosomal aberrations of unicellular mice embryos after incubation with tritiated substances during different phases of the cell cycle.** Heckeley, N.; Mueller, W.U.; Streffer, C. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Inst. fuer Medizinische Strahlenbiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16111 (INIS-mf—11882, pp v) **Influence of chromatin-condensation on the radiosensitivity of mammalian cells.** Seibold, G.; Sattler, E.L. (Giessen Univ. (Germany, F.R.). Strahlenzentrum). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16112 (INIS-mf—11882, pp v) **Survival, mutations and transformation of mammalian cells following irradiation.** Sontag, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16113 (INIS-mf—11882, pp v) **Cell cycle effects of CHO cells after irradiation with low LET irradiation as measured by survival curves, DNA strand breaks and repair.** Wolf, H.; Markus, B. (Goettingen Univ. (Germany, F.R.). Abt. Klinische Strahlenbiologie und Klinische Strahlenphysik). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16114 (INIS-mf—11882, pp v) **In-vitro studies on the X-rays radiosensitivity of canine bone marrow erythroid burst forming units (BFU-E) and fibroblast forming units (CFU-F).** Kreja, L.; Baltschukat, K.; Nothdurft, W. (Ulm Univ. (Germany, F.R.). Inst. fuer Arbeits- und Sozialmedizin). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16115 (INIS-mf—11882, pp v) **Selective inhibition of repair in tumor cells by inhibitors of energy metabolism.** Pohlit, W.; Latz, D.; Thonke, A. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Frankfurt am Main (Germany, F.R.). Abt. fuer Biophysikalische Strahlenforschung). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16116 (INIS-mf—11882, pp v) **Experimental radiotherapy of R1H tumors.** Beck-Bornholdt, H.P. (Hamburg Univ. (Germany, F.R.). Inst. fuer Biophysik und Strahlenbiologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16117 (INIS-mf—11882, pp v) **Kinetics of recovery from sublethal damage in the mouse mammary carcinoma AT17.** Guttenberger, R.; Kummermehr, J.; Sund, M. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Strahlenbiologie; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Medizinische Informatik und Systemforschung (Medis)). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16118 (INIS-mf—11882, pp v) **Activated retrotransposons, and their influence on cell differentiation.** Erfle, V.; Casser-Bette, M.; Closs, E.I.; Schmidt, J. (Gesellschaft fuer Strahlen- und Umweltforschung Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Molekulare Zellpathologie). 1988. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16119 (INIS-mf—11882, pp v) **Cat-2/sup t/: Radiation induced dominant cataract mutation in mice.** Graw, J.; Kratochvilova, J.; Bors, W.; Michel, C.; Schaeffer, E.; Summer, K.H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Saeugetiergenetik; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Strahlenbiologie; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Pathologie; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Toxikologie). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16120 (INIS-mf—11882, pp v) **Adaptive response - a general phenomenon in mammalian cells?.** Hieber, L.; Greinert, R.; Ponsel, G.; Trutschler, K.; Fenn, S.; Kellerer, A.M. (Wuerzburg Univ. (Germany, F.R.). Inst. fuer Medizinische Strahlenkunde). 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756614/JAW. (CONF-8803186—).

From 3. symposium on molecular and cellular mechanisms of biological radiation effects; Neuherberg, F.R. Germany (23 Mar 1988).

16121 **(IPEN-PUB—209) Standardization of the biological control of /sup 67/ Ga-citrate in rats and mice.** Muramoto, E.; Barbosa, M.F. de; Achando, S.S.; Pereira, N.P.S. de; Silva, C.P.G. da. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705550/JAW.

/sup 67/Ga-citrate is frequently used in Nuclear Medicine for tumor diagnosis. This study established the biological distribution parameters in rats with experimental abscesses in the left thigh. The biological model choosen made possible the routine control of /sup 67/Ga-citrate giving a realiable result in a relative short-time (60 min.) after the radionuclide administration.

16122 **(IPEN-PUB—210) Biological /sup 60/Co radiation effects on mouse embryos in the presence of sodium selenite.** Bellini, M.H.; Mastro, N.L. del. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Sep 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705551/JAW.

A single dose of sodium selenite (0,5 mg Se/Kg b.w.) was injected intraperitoneally into mice on day 17 pregnancy, 2h before 1.5 and 3.0 Gy whole body gamma irradiation. Irradiation produced a growth impairment in the newborns. Weight improvement as a function of age offspring from irradiated mice decreased proportionally to applied dose. Administration of selenite results also in a decrease of growth rate. Nevertheless, when irradiation and selenite treatments were combined, no additive effect can be observed, suggesting that selenium pretreatment would exert some protection against radiation-induced retardation of growth.

16123 **(LBL—26327) Factors that modify risks of radiation-induced cancer.** Fabrikant, J.I. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 19p. (CONF-8810258—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006670/JAW.

From Electric Power Research Institute workshop; San Diego, CA, USA (18 Oct 1988).

The collective influence of biologic and physical factors that modify risks of radiation-induced cancer introduces uncertainties sufficient to deny precision of estimates of human cancer risk that can be calculated for low-dose radiation in exposed populations. The important biologic characteristics include the tissue sites and cell types, baseline cancer incidence, minimum latent period, time-to-tumor recognition, and the influence of individual host (age and sex) and competing etiologic influences. Physical factors include radiation dose, dose rate, and radiation quality. Statistical factors include time-response projection models, risk coefficients, and dose-response relationships. Other modifying factors include other carcinogens, and other biological sources (hormonal status, immune status, hereditary factors).

16124 **(NUREG/CR—5276) SADDE (Scaled Absorbed Dose Distribution Evaluator): A code to generate input for VARSKIN.** Reece, W.D.; Miller, S.D.; Durham, J.S. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation; Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 63p. (PNL—6761). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89007109/JAW.

The VARSKIN computer code has been limited to the isotopes for which the scaled absorbed dose distributions were provided by the Medical Internal Radiation Dose (MIRD) Committee or to data that could be interpolated from isotopes that had similar

spectra. This document describes the methodology to calculate the scaled absorbed dose distribution data for any isotope (including emissions by the daughter isotopes) and its implementation by a computer code called SADDE (Scaled Absorbed Dose Distribution Evaluator). The SADDE source code is provided along with input examples and verification calculations. 10 refs., 4 figs.

16125 **(ORAU—88/H-99) Guide to good practice in radiation protection training.** Johnson, N.; Schenley, C.; Smith, A.; Weseman, M. (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1988. Contract AC05-76OR00033. 120p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006637/JAW.

This set of guidelines applies to radiation protection training programs for all Department of Energy (DOE) contractors, subcontractors, and visitors to DOE contractor facilities. It is to be used as a self-evaluation tool by DOE contractors as they develop and evaluate their training programs. This document is based on good practice guidelines used by a variety of different facilities both within and outside of the DOE contractor system. Good practices are not requirements; they are guidelines that contractors should use as they develop and conduct training programs. The applicability of the contents of the Guide to Good Practice in Radiation Protection Training depends upon each DOE facility's scope and need for radiation safety training. Although the focus of this document is radiation protection training, it is important that the process by which training is developed and implemented be discussed. Therefore, the first section presents guidelines for performance-based training and ideas to be considered regarding the structure and documentation of the training function.

16126 **(PNL—6767) Development of a portable blood irradiator for potential clinical uses.** Hungate, F.P. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 73p. NTIS, PC A04 - OSTI. Order Number DE89007007/JAW.

This document provides an account of the development of a fully portable blood irradiator and the evaluation of its safety and efficacy when implanted in goats, sheep, a baboon and dogs. The program was initiated because the control of lymphocyte populations by irradiation is a potential method for improving success in organ or tissue transplantation and for treating a variety of blood diseases. 15 refs., 27 figs., 2 tabs.

16127 **(PNL-SA—16029) Controlling dose to individual cells.** Braby, L.A.; Reece, W.D. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 9p. (CONF-8810209—12). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006940/JAW.

From 27. Hanford life sciences symposium on health and the environment; Richland, WA, USA (18 Oct 1988).

The biological effects of irradiation begin with the production of ionized or excited molecules by passage of charged particles through the cell. These ionizations are concentrated along the path of the charged particle and the density of ionization varies dramatically with the type and velocity of the particle. Because the stochastic effects of irradiation, such as cancer induction, begin with damage to the DNA of a single cell, it is generally assumed that the dose delivered to an individual cell nucleus will correlate with the probability of damage to that cell and to the risk of adverse health effects. The dose to a cell nucleus which has been traversed by a single proton, the most common charged particle produced by neutron irradiation, is a random variable which depends on the actual number of ions produced, the mass of the nucleus, and other factors, but is typically on the order of 0.2 Gy. When an animal or a collection of cells in an experimental dish is exposed to a lower dose of neutrons, 0.02 Gy for example, some of the nuclei are traversed by recoil protons, and others are not. The average dose to those which are hit by a proton is the 0.2 Gy, but the average including the 9 out of 10 undamaged cells is 0.02 Gy. 1 fig., 1 tab.

16128 **(PNL-SA—16158) Mechanistic explanations for the elevated susceptibility of the perinatal thyroid gland to radiogenic cancer.** Sikov, M.R.; Mahlum, D.D.; Dagle, G.E.; Daniel, J.L.; Goldman, M. (Pacific Northwest Lab., Richland, WA (USA)). 6 Dec 1988. Contract AC06-76RL01830. 11p. (CONF-8810209—11). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006943/JAW.

From 27. Hanford life sciences symposium on health and the environment; Richland, WA, USA (18 Oct 1988).

Results from laboratory experiments and epidemiologic studies suggest that the thyroid gland is more susceptible to radiogenic cancer during the late prenatal or early postnatal periods than in adulthood. We have evaluated several endpoints in the course of experiments in which rats, at ages ranging from late gestation to adulthood, were exposed to graded doses of ^{131}I. Morphologic responses at sequential times after exposure were evaluated in one series of experiments. Cell death, degeneration, fibrosis of the gland were the predominant findings after exposure of weanlings or adults, but inhibition of thyroid growth and differentiation was the characteristic change after perinatal exposure. The degree of maturation and dosimetric factors are involved in this differential morphologic response, and also result in age-dependent physiologic differences in the postexposure period.

16129 **(UCRL—99895) Radiolethal and genetic vulnerabilities of germ cells in the female mammal: Effects of tritium and other radiations compared.** Straume, T.; Kwan, T.C.; Goldstein, L.S.; Dobson, R.L. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 10p. (CONF-881190—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006778/JAW.

From 3. Japan-US workshop on tritium radiobiology and health physics; Kyoto, Japan (8 Nov 1988).

Our focus is on the nature of the lethality target in very sensitive cells. In the mouse, several types of radiations have now been used, including ^{3}H-Tdr incorporated into oocyte DNA, gamma rays delivered at various dose rates, 250 kVp x rays, neutrons of various energies, and three kinds of accelerated heavy ions (Si^{14+}, Ar^{18+}, Fe^{26+}). We have shown that the lethality target in mouse immature oocytes is non-nuclear; it is equal in cross-sectional area to the entire oocyte and is separated from the nucleus by about 4 μm. A substantial body of data now points to the plasma membrane as the lethality target in these particular cells. We have quantified both chromosome aberrations and dominant lethal mutations in oocytes from females exposed 8 to 12 weeks earlier. Results from these and other studies show that: (1) for immature oocyte killing in mice, chronically administered ^{3}HOH is of near maximum biological effectiveness, similar to the most effective neutrons and heavy ions (likely true also for female germ-cell killing in some prenatal primates), (2) tritium incorporated into DNA as ^{3}H-Tdr is about 100 times less effective in mouse immature oocyte killing than is tritium administered as ^{3}HOH, and (3) for mutagenicity in the mouse, immature oocytes appear to have approximately the same sensitivity as mature oocytes and show dose and LET responses similar to those obtained from genetic studies of other cells. The possible implications of these findings for women exposed to tritium are considered.

16130 **Mortality of workers at the Hanford site: 1945-1981.** Gilbert, E.S.; Petersen, G.R.; Buchanan, J.A. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **56**: No. 1, 11-25(Jan 1989).

Analyses of mortality of workers at the Hanford Site were updated to include an additional three years of data (1979-81). Deaths occurring in the state of Washington in the years 1982-85 were also evaluated. Hanford workers continued to exhibit a strong healthy worker effect with death rates substantially below those of the general U.S. population. Comparisons by level of radiation exposure within the Hanford worker population provided no evidence of a positive correlation of radiation exposure and mortality from all cancers combined or of mortality from leukemia. Estimates of cancer risk due to radiation were negative, but confidence intervals were wide, indicating that the data were consistent with no risk and with risks several times larger than estimates provided by major groups concerned with risk assessment. Of 18 categories of cancer analyzed, a correlation of borderline statistical significance

was identified for female genital cancers ($p = 0.05$), but was interpreted as probably spurious. The previously identified correlation for multiple myeloma persisted ($p = 0.002$).

16131 Global impact of the Chernobyl reactor accident. Anspaugh, L.R.; Catlin, R.J.; Goldman, M. (Lawrence Livermore National Lab., Livermore, CA (USA)). *Science (Washington, D.C.);* **242**: No. 4885, 1513-1519(16 Dec 1988).

Radioactive material was deposited throughout the Northern Hemisphere as a result of the accident at the Chernobyl Nuclear Power Station on 26 April 1986. On the basis of a large amount of environmental data and new integrated dose assessment and risk models, the collective dose commitment to the approximately 3 billion inhabitants is calculated to be 930,000 person-gray, with 97% in the western Soviet Union and Europe. The best estimates for the lifetime expectation of fatal radiogenic cancer would increase the risk from 0 to 0.02% in Europe and 0 to 0.003% in the Northern Hemisphere. By means of an integration of the environmental data, it is estimated that approximately 100 petabecquerels of cesium-137 (1 PBq = 10(15) Bq) were released during and subsequent to the accident.

16132 Promotion of pulmonary carcinogenesis by plutonium particle aggregation following inhalation of $^{239}PuO_2$. Sanders, C.L.; McDonald, K.E.; Lauhala, K.E. (Pacific Northwest Lab., Richland, WA (USA)). *Radiation Research;* **116**: No. 3, 393-405(Dec 1988).

Promotion of lung tumor formation from inhaled $^{239}PuO_2$ in rats may be associated with aggregation of plutonium particles near bronchioles. The relationship of plutonium particle aggregation in the lung and the development of lung tumors after inhalation of $^{239}PuO_2$ was studied in 664 life span rats with mean lung doses ranging from 0.35 to 20 Gy. Plutonium particle concentration and aggregation were determined from autoradiographic sections of the left lung lobe. The increase in particles/cm2 and mean number of particles per aggregate up to 20 Gy were directly proportional to lung dose. Aggregates with greater than 25 particles increased linearly with dose from 0.2% at 1.4 Gy to 8.2% at 20 Gy, in a pattern similar to increasing severity of pulmonary fibrosis and incidence of lung tumors. Lung tumor incidence increased from about 6% at 1.4 Gy to 83% at 8 Gy; no further increase in lung tumors was seen at doses greater than 8 Gy. Maximum lung tumor incidence at 8 Gy corresponded to a particle concentration of 130/cm2 and four particles/aggregate with 4% of aggregates having greater than 25 particles. Aggregation of inhaled plutonium particles in clusters of greater than 25 particles resulted in daily doses of only a few centigray to focal tissue regions containing clustered particles, yet these doses appeared sufficient to cause pulmonary fibrosis and promotion of pulmonary carcinogenesis.

16133 SEM of canine chromosomes: normal structure and the effects of whole-body irradiation. Niiro, G.K.; Seed, T.M. (Argonne National Lab,, IL (USA)). *Scanning Miscroscopy;* **2**: No. 3, 1593-1598(Sep 1988).

Canine chromosomes are not only numerous (38 autosomal pairs), but they are small (compared to human chromosomes) and morphologically similar as well. Analysis of the canine karyotype by light microscopy (LM) of banded chromosomes is, thus, difficult, and the literature on the canine karyotype is scanty. In this study, we describe examination of chromosomes from normal and chronically irradiated dogs with the scanning electron microscope (SEM). Metaphase chromosomes from bone marrow aspirates were Giemsa-banded with either 0.025% trypsin alone or 0.1% trypsin preceded by 10% H2O2 and prepared for SEM. Examination of chromosomes from normal dogs revealed cylindrical chromosome profiles with well-defined chromatids and centromeres. The chromosome arms were consistently marked by periodic grooves that had complementary structures on sister chromatids and may represent the trypsin-sensitive chromatic regions. The quality of the preservation varied from preparation to preparation and depended on the concentration and time of trypsin treatment. Chromosomes from irradiated dogs revealed translocations, deletions, and gaps. We conclude that SEM produces images superior to LM images of canine chromosomes; SEM images can be used not only to identify individual chromosomes, but also to identify genetic lesions in the chromosomes of chronically irradiated dogs. We further conclude that the two Giemsa-banding protocols used in the present study produced variable results, although 0.025% trypsin alone appeared to give better and more consistent results than 0.1% trypsin preceded by 10% H2O2.

16134 Developmental and radiobiologic characteristics of canine multinucleated, osteoclast-like cells generated in vitro from canine bone marrow. Seed, T.M.; Kaspar, L.V.; Domann, F.; Niiro, G.K.; LeBuis, D.A. (Argonne National Lab,, IL (USA)). *Scanning Miscroscopy;* **2**: No. 3, 1599-1611(Sep 1988).

We report here our initial observations on the growth and morphology, and developmental radiosensitivity of giant, multinucleated, osteoclast-like cells (MN-OS) generated through in vitro cultivation of hematopoietic progenitor-enriched canine bone marrow samples. Maximum cell densities of 5.5 x 10(3) to 6.5 x 10(3) MN-OS per cm2 of growth area were achieved following 10 to 14 days of culture at 37 degrees C. Acute gamma irradiation of the initial marrow inocula resulted in significant, dose-dependent perturbations of MN-OS formation, growth, and development. Attempts to estimate radiosensitivity of MN-OS progenitors from canine marrow yielded a range of Do values from a low of 212 cGy measured at six days of culture to higher values of 405 to 542 cGy following 10 to 22 days of culture. At the intermediate times of culture (10 to 14 days), the radiation-induced responses were clearly biphasic, reflecting either (a) the presence of multiple subpopulations of MN-OS progenitors with varying degrees of radiosensitivity or (b) the inherent biphasic nature of MN-OS development involving early progenitor cell proliferation followed by maturation and subsequent fusion. Morphologically, MN-OS generated from irradiated marrow inocula appeared only marginally altered, with alterations expressed largely in a biphasic, dose-dependent fashion in terms of smaller cell size, reduced number of nuclei, increased expression of both surface microprojections, and a unique set of crystalloid cytoplasmic inclusions. Functionally, MN-OS appeared to be impaired by irradiation of marrow progenitors, as evidenced by failure to initiate resorptive attachments to devitalized bone spicules in vitro.

16135 Scanning electron microscopic autoradiography of lung. Lauhala, K.E.; Sanders, C.L.; McDonald, K.E. (Pacific Northwest Lab., Richland, WA (USA)). *Scanning Miscroscopy;* **2**: No. 3, 1631-1634(Sep 1988).

Scanning electron microscopic (SEM) autoradiography of the lung is being used to determine the distribution of inhaled, alpha particle-emitting, plutonium dioxide particles. SEM autoradiography provides high visual impact views of alpha activity. Particles irradiating the bronchiolar epithelium were detected both on the bronchiolar surface and in peribronchiolar alveoli. The technique is being used to obtain quantitative data on the clearance rates of plutonium particles from bronchi and bronchioles.

16136 Perspectives on radiation dose estimates for A-bomb survivors. Loewe, W.E. (Lawrence Livermore National Lab. (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

For decades after the actual events, quantitative characterization of the radiation fields at Hiroshima and Nagasaki continues to be sought, with high accuracy a goal justified by the unique contribution to radiation protection standards that is represented by the medical records of exposed survivors. The most recent effort is distinguished by its reliance on computer modelling and concomitant detail, and by its decentralized direction, both internationally and internally to the U.S. and Japan, with resultant ongoing peer review and wide scope of inquiry. A new system for individual dose estimation has been agreed upon, and its scientific basis has been elaborated in the literature as well as in a comprehensive treatise to be published in the Spring of 1987. In perspective, this new system appears to be an unusually successful achievement that offers the expectation of reliable estimates with the desired accuracy. Some aspects leading to this expectation, along with a caveat, are discussed here.

16137 **Sensitivity/uncertainty analysis for the Hiroshima dosimetry reevaluation effort.** Broadhead, B.L.; Lillie, R.A.; Pace, J.V. III; Cacuci, D.G. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

Uncertainty estimates and cross correlations by range/survivor location have been obtained for the free-in-air (FIA) tissue kerma for the Hiroshima atomic event. These uncertainties in the FIA kerma include contributions due to various modeling parameters and the basic cross section data and are given at three ground ranges, 700, 1000 and 1500 m. The estimated uncertainties are nearly constant over the given ground ranges and are approximately 27% for the prompt neutron kerma and secondary gamma kerma and 35% for the prompt gamma kerma. The total kerma uncertainty is dominated by the secondary gamma kerma uncertainties which are in turn largely due to the modeling parameter uncertainties.

16138 **Estimation of the systemic burden of plutonium from urinary excretion data and a multi-exponential model for excretion in comparison with autopsy data.** Bernard, S.R.; Nestor, C.W. (Oak Ridge National Lab., PO Box Y, Oak Ridge, TN (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

The authors have adapted other's method for computing the systemic burden from urinary excretion data to use a multi-exponential model (2) for excretion, rather than Langham's power function. The mathematical basis of Synder's method is the representation of the systemic burden as the convolution integral of the observed urinary excretion data with the inverse Laplace transform of the excretion function; in the case of urinary excretion of plutonium, the power function has a Laplace transform, but for other elements (notably uranium) it does not. If the method is to be used for other radioisotopes, the excretion function must have a Laplace transform, and for this reason we have used a multi-exponential form of the excretion function. They have written a computer program to calculate estimates of the systemic burden and the integrated intake from urinary excretion data, and have compared the results with two cases for which autopsy data are available, as presented in this paper.

16139 **Background levels of Radium-226 in urine.** Ide, H.M.; Moss, W.D.; Thomas, R. (Health, Safety, and Environmental Div. Office, Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

This paper presents data on the concentration of /sup 226/ Ra in employees of the Los Alamos National Laboratory and is offered as evidence of background levels for this population. These data will help to fill that void. Selected groups of Los Alamos employees were invited to participate in the study which involved the collection of at least 400 cm/sup 3/ of urine. Included in these groups were: 1. Chemists who work exclusively with uranium; 2. Machinists who worked exclusively with uranium; 3. Chemists in the occupational health laboratory; 4. Industrial hygiene field engineers; and, 5. Chemical research workers. Samples of drinking water associated with the work areas were also analyzed. The emanation method for determining the radium-226 in urine was used because of its sensitivity and specificity. All samples and standards were allowed to age for at least 31 days before de-emanation and counting to issue maximum sensitivity of the measurement. These background measurements ranged in value from 0.023 to 0.177 pCi/ 400 cm/sup 3/ of urine.

16140 **Uranium analysis of human tissue using delayed neutron counting.** Gonzales, E.R.; McInroy, J.; Boyd, H.; Gladney, E. (Los Alamos National Lab., Los Alamos, NM (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

Delayed neutron analysis (DNA) is an extension of neutron activation analysis that is applicable to fissionable elements usch as uranium. At Los Alamos National Laboratory the authors investigated the suitability of DNA to determine uranium concentrations in human tissue. They studied various sample preparation techniques and concluded that DNA counting of wet tissues shows little variation from DNA counting of ashed tissues. The subsequent radiochemical analysis and alpha spectrsocopy counting of the same samples confirmed the accuracy and precision of the values obtained by DNA method. A minimum detection amount (MDA) for 10 g wet tissue was 1 ppb. They concluded that DNA has good potential in uranium analysis over other radiochemical analysis methods in terms of speed, accuracy, precision, and MDA.

16141 **A study of the comparison between human and animal excretion data following inhalation exposure to plutonium 238 oxide aerosols.** Moss, W.D.; Martinez, G.; Gautier, M.A. (Los Alamos National Lab., HSE-9, MS K484, Los Alamos, NM (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

Bioassay urine samples obtained since 1971 from eight Los Alamos employees, accidentally exposed by inhalation to high-fired plutonium-238 oxide aerosols, were studied and compared with excretion data obtained from Beagle dogs exposed to /sup 238/PuO/ sub 2/ aerosols. The early period Pu human excretion data from the inhalation exposure were unexpected and were unlike previously studied occupational exposure urinary data obtained at Los Alamos. The initial urine samples collected on day one were below the detection limits of the analytical method (0.01 pCi). Within thirty days, however, detectible concentrations of Pu were measured in the urine for several of the exposed personnel. The amounts of Pu excreted continued to increase in each of the cases throughout the first year and the individual patterns of Pu excretion were similar. The human urinary excretion data was compared with similar excretion data obtained from an animal study conducted by the Inhalation Toxicology Research Institute (Me81). In the animal study, Beagle dogs received inhalation exposure to one of three sizes of monodisperse of polydisperse aerosol of /sup 238/PuO/sub 2/. Periodic sacrifice of pairs of dogs during the 4 years after the inhalation exposure provided data on the retention, translocation and mode of excretion of /sup 238/Pu. The comparison of human and animal /sup 238/Pu excretion data supported the observation that the excretion data were similar between the two species and that the animal excretion models can be applied to predict the human / sup 238/Pu excretion following inhalation exposure to high-fired oxides of /sup 238/Pu.

16142 **A comparative study of pulsed-laser fluorimetric and radiochemical determination of uranium in a urinalysis program.** Warner, D.A. (Rockwell International, Rocky Flats Plant, PO Box 464, Golden, CO (US));. pp v of Proceedings of the thirtieth annual conference on bioassay, analytical and environmental chemistry. Cincinnati, OH; NLO, Inc. (1985). (CONF-8410197—).

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

A method utilizing a pulsed-laser fluorimeter for the determination of trace levels of uranium in urine is evaluated as an alternative to the radiochemical separation and alpha spectrometric measurement of the element. The pulsed-laser fluorimeter is a compact electro-optical instrument which measures the fluorescence of a uranyl complex formed by adding an analytical reagent to the sample. Fluorescence of the uranyl complex is the result of ultraviolet excitation generated by a nitrogen laser tube. Sample prepa-

ration requires the complete oxidation of all organics which could contribute to the fluorescence signal. Results from the analysis of pooled and artificial urine by both methods are compared. The accuracy of each method is comparable for those experiments. Additional work is in progress to determine the feasibility of using the pulsed-laser fluorimetric method in a urinalysis feasibility of using the pulsed-laser fluorimetric method in a urinalysis program. The advantages and disadvantages of each method are reviewed.

16143 **Pulmonary clearance.** pp v of Occupational and industrial hygiene: Concepts and methods: A symposium in honor of Theordore F. Hatch. Esmen, N.A.; Mehlman, M.A. (Div. of Toxicology, Dept. of Radiation Biology and Biophysics, Univ. of Rochester School of Medicine, Rochester, NY (US));. Princeton, NJ; Princeton Scientific Publisher (1984).

Particle retention in the human respiratory system can be defined as the persistence of deposited particles in respiratory tissues with time; therefore, it is equivalent to particle deposition minus particle clearance. This paper reviews the development of pulmonary retention studies of aerosols and the way in which the initial application to radionuclide dosimetry has expanded to include dose relationships for all particulate materials and pulmonary functional assessments. The basic methodologies for measuring and analyzing particle retention are described and some limitations discussed. Representative kinetic descriptions are also included.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 14238, 14281, 14652, 15484, 15933, 16005

16144 **(EPRI-EA—6189) Precision of the EPA Seven-Day Fathead Minnow Larval Survival and Growth Test: Intra- and interlaboratory study: Final report.** DeGraeve, G.M.; Cooney, J.D.; Pollock, T.L.; Reichenbach, N.G.; Dean, J.H.; Marcus, M.D.; McIntyre, D.O. (Electric Power Research Inst., Palo Alto, CA (USA); Battelle Columbus Div., OH (USA)). Jan 1989. 204p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006680/JAW.

The US Environmental Protection Agency (US EPA) has recently developed a "Seven-Day Fathead Minnow Larval Survival and Growth Test" for measuring the toxicity of effluents. This study evaluated the intra- and interlaboratory variability of this seven-day test using two reference toxicants (sodium pentachlorophenate and potassium dichromate), two treated refinery effluents, and one untreated internal utility waste stream. Ten different laboratories, representing academia, private industry, contractors, State EPA and US EPA participated in the study. The reference toxicants were tested twice during two separate test periods and each industrial effluent was treated once during a single period. Weight NOEC values were generally similar to those for survival, but had substantially greater variability than survival NOEC values. Increasing the number of replicate test chambers from two to three increased the test sensitivity and decreased the variability in NOEC values. Overall this chronic test procedure was moderately easy to carry-out for experienced laboratories and appears to be a precise method for estimating toxicity. The laboratories were able to successfully complete 126 of 140 tests. Nine of the 14 unsuccessful completed tests were invalid because survival of larvae in control exposures was below the US EPA's survival criterion of 80% for chronic bioassays. 26 refs., 13 figs., 40 tabs.

16145 **(GSF—9/87) 2nd international symposium on air pollution and plant metabolism. Workshop- and poster-presentations.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)). Apr 1987. 124p. (CONF-8704365—Summs.). NTIS (US Sales Only), PC A06. Order Number DE88756622/JAW.

From 2. international symposium on air pollution and plant metabolism (IS-APPM-2); Neuherberg, F.R. Germany (6 Apr 1987).

At the second International Symposium on Air Pollution and Plant Metabolism eight workshop-presentations and 31 poster-presentations were given. They all deal with the effects of air pollutants as ozone, sulfur dioxide, nitrogen dioxide and others more on plants.

16146 **(GSF—26/87) Role of photochemical oxidants and other atmospheric trace elements in the context of forest decline in the Alps.** Schulte-Hostede, S.; Kirchner, M.; Reuther, M.; Maier, B. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)). Sep 1987. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756623/JAW.

Measurements of air pollutants have been carried out in the Alps. Especially the role of photochemical oxidants as ozone, PAN, HMP, H/sub 2/O/sub 2/ and others have been investigated. Origin and measurement of photochemical oxidants are described as well as biological monitoring of metals as lead, cadmium and zinc by plants. A valuation of the results is given.

16147 **(ININ-GSTN—002-88) Heavy metals analysis in blood by the X-ray fluorescence method.** Perez Novara, Ana Ma. (Instituto Nacional de Investigaciones Nucleares, Mexico City). (Instituto Nacional de Investigaciones Nucleares, Mexico City). May 1988. 19p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705378/JAW.

The analytical procedure for determination of heavy metals in blood is described. Blood was taken from active smelter workers, samples were stored in special flasks at 2 grades C. After freeze drying, dried samples was analyzed using X-ray fluorescence, sources excited: Pu-238 and Cd-109 was used. Br in Pb interferences were corrected. The agreement of the results with values in similar workers is satisfactory Median Pb level was 42.6 micro grams/100 ml (total blood), Cu was less 2.5 micro grams/g (dry blood) and Zn was 11 micro grams/g (dry blood).

16148 **(NP—9770222) Investigations on distribution of copper in soil, vegetation and soil fauna of a vineyard ecosystem.** Wittassek, R. (Bonn Univ. (Germany, F.R.). Landwirtschaftliche Fakultaet). 14 Jul 1987. 182p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE89770222/JAW.

Investigations were carried through to test the effects of different copper contents in soils on soil fauna. The experiments were carried out in vineyards. Soil copper contents were correlated with the contents in invertebrates as parthworms, spiders, beetles and others more. The results show, that the biological accumulation changes with food, temperature and animal species. Good biological indicators for copper in terrestrial ecosystems are spiders.

16149 **(NP—9770223) Effect of fumigation by sulfur dioxide, ozone and nitrogen dioxide on nitrogen metabolism of sterile cultivated Norway spruce seedlings (Picea abies (L.) Karst.).** Peuke, A.D. (Goettingen Univ. (Germany, F.R.)). 2 Jul 1987. 114p. (In German). NTIS (US Sales Only), PC A06. Order Number DE89770223/JAW.

Nitrogen metabolism of sterile cultivated Norway spruce seedlings was analysed. This happened under fumigation by sulfur dioxide, nitrogen dioxide and ozone. Nitrate content and activity of nitrate reductases were measured in root and stem using different variants of fumigation and nutrition. The impeding effects of fumigation are discussed.

16150 **(ORNL/TM—10849) DNA adduct formation by twelve chemicals with populations potentially suitable for molecular epidemiological studies.** Uziel, M.; Munro, N.B.; Katz, D.S.; Vo-Dinh, T.; Zeighami, E.A. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 109p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006931/JAW.

The feasibility of an epidemiological study using molecular biomarkers or adducts as quantitative measures of exposure and predictors of adverse health effects depends on several variables. This manuscript focuses on how adducts are formed and whether

they are stable long enough to be detected; and the degree of understanding of the relationship between the biomarker and the specific biological response of concern (e.g., carcinogenesis, mutation, etc.). Selection of the chemicals---eight individual chemicals and a group of three benzidine-related chemicals---was made by comparing potential study population quality and availability with DNA adduct information from two lists (94 chemicals reported to form DNA adducts and 283 chemicals taken from the EPA/HERL genotoxicity list). A novel approach to population analysis was used to put priorities on the chemicals for review. 218 refs., 23 tabs.

16151 **(PB—89-129878/XAB) Gas and particle deposition in tracheobronchial airways. Report for 28 September 1984-31 August 1987 (Final).** Cohen, B.S. (New York Univ., NY (USA). Inst. of Environmental Medicine). 31 Aug 1987. 16p. NTIS, PC A03/MF A01.

Gas and aerosol deposition efficiency in lung airways of humans and animals were investigated under two different airflow patterns: steady inspiratory flow and pulsatile inspiratory flow. The differences and similarities between deposition patterns in the human dichotomous branching tracheobronchial tree and the canine monopodial branching were documented. Hollow airway casts were prepared from whole lungs obtained at autopsy from a 45-year-old man and from a mixed-breed dog. Morphometric measurements were made on the casts through the fifth generation for all airway branches and to the terminal airways along a major branch path, a minor branch path, and a path that alternately selects major and minor branches. Flow measurements were made for inspiratory flow and pulsatile inspiratory flow. Pulsatile inspiratory flow was found to be more realistic than steady flow in this model. The hollow airway cast system was evaluated for use in investigations of patterns of gas transfer to airway surfaces.

16152 **(PB—89-129969/XAB) Petroleum-solvent mortality study of Oklahoma dry cleaners. Volume 1. Final report, 1 January 1986-31 March 1988.** Asal, N.R.; Coleman, R.L.; Petrone, R.L.; Owen, W.; Walsworth, S. (Oklahoma Univ., Oklahoma City (USA). Health Sciences Center). 30 Jun 1988. 111p. NTIS, PC A06/MF A01.

See also Volume 2, PB—89-129977.

The records of the Board of the Oklahoma State Dry Cleaners were used in a study on the effects of chronic, occupational exposures to petroleum dry-cleaning solvents. The historical licensure records maintained by the Board made it possible to study a well defined cohort of dry cleaners for which there is information on solvent exposure and duration of exposure. Volume 1 consisted of a review of the literature with information provided concerning the history of dry cleaning, description of the industry, legislation affecting the industry, a description of the process, equipment used, emission sources, levels of solvent exposure, exposure limits, the chemistry of petroleum hydrocarbons, animal toxicology, mutagenicity, teratogenicity, tumor production, human effects, and cancer mortality among oil-refinery workers. Volume 2 is also available.

16153 **(PB—89-129977/XAB) Petroleum solvent mortality study of Oklahoma dry cleaners. Volume 2. Final report, 1 January 1986-31 March 1988.** Asal, N.R.; Coleman, R.L.; Petrone, R.L.; Owen, W.; Walsworth, S. (Oklahoma Univ., Oklahoma City (USA). Health Sciences Center). 30 Jun 1988. 169p. NTIS, PC A08/MF A01.

See also Volume 1, PB—89-129969; Portions of this document are not fully legible.

The association between exposures to the primary petroleum solvents used in commercial dry-cleaning processes and various causes of death was investigated. Each commercial dry-cleaning establishment in Oklahoma was classified according to the solvent or solvents in use from 1941 to 1983, based on data from the State Dry Cleaners Board. A cohort with known solvent exposures was identified. The proportionate mortality ratios and standardized mortality ratios were determined for all major causes of death. Nearly 59% were white males, with an average exposure of 10.5 years. No excess in overall cancer mortality was found. Significant excesses were noted for mental, psychoneurotic, and personality disorders due to alcoholism; genitourinary system due to acute nephritis, chronic nephritis, and renal sclerosis; bone and organ movement due to arthritis and spondylitis. An excess in cancers of the respiratory system was identified with excesses in mortality due to trachea, bronchus, and lung cancer among those dying at age 65 or older. A 45% excess in proportionate mortality due to pancreatic cancer was found. Only on analysis of petroleum-solvent exposure to white males was an excess found for kidney cancer. Moderately increased incidents of skin and bone cancer were found. Volume 1 is also available.

16154 **(UBA-FB—85-059/1) Improvement of selected indication methods with plants for the surveying network of air pollution in Lower Saxony. Pt. 1. Iris hollandica for biological monitoring.** Koester, W.; Merkel, D. (Landwirtschaftskammer Hannover, Hameln (Germany, F.R.). Landwirtschaftliche Untersuchungs- und Forschungsanstalt; Umweltbundesamt, Berlin (Germany, F.R.)). Dec 1985. 59p. (In German). Copy held by UB/TIB Hannover.

Verification of a biological monitoring method for heavy metal accumulation with Iris hollandica. With Iris hollandica, fluoride immissions can be registered proportionally as with rye grass. Fluoride concentrations in the dry matter of rye grass, however, are always greater than in Iris hollandica. Cultivation of Iris hollandica in soil is advantageous as compared to cultivation in hydroponic. The exposition of iris plants, aged 6-8 weeks, for a period of 14 days is recommended. There were positive results from experiments to monitor the deposition of lead and cadmium with this method. Effects of fluoride immissions on the fruit trees apple, pear and plum in the neighborhood of an aluminium plant were investigated. (orig./KG) With 26 tabs., 8 figs.

16155 **Inhibition of chemical carcinogenesis.** Slaga, T.J.; DiGiovanni, J. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp v of Chemical carcinogens: Second edition, revised and expanded. Volume 2. Searle, C.E. Washington, DC; American Chemical Society (1984).

In addition to the wide variety of known or suspected chemical carcinogens found dispersed in our environment, a vast number of other pharmacologically active foreign substances is present. Many of these compounds are known to modify (inhibit or enhance) the development of tumors in response to various carcinogenic agents in experimental animals. Epidemiological studies have suggested that specific pharmacologically active agents present in the diet may reduce the relative risk of carcinogens. This chapter focuses on inhibitors of chemical carcinogenesis in experimental animals. Interest in chemical inhibitors of carcinogenesis is twofold: (1) inhibitors provide valuable tools for studying the biochemical and molecular mechanism(s) of carcinogenesis, and understanding the chemical nature, mechanism(s), and specificity of inhibitors may lead to a rational approach for the chemoprevention of chemically induced tumors in humans.

16156 **Distribution and elimination of [/sup 14/C]-phenanthridone in rats after inhalation.** Dutcher, J.S.; Mitchell, C.E. (Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, P.O. Box 5890, Albuquerque, NM (US)). pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

The presence of aza-arenes (nitrogen containing heterocyclic aromatic compounds) in the environment and in potential environmental pollutants is well established. These compounds have been found in urban air and cigarette smoke, marine sediments, effluents from coal and oil combustion and automobile exhaust, petroleum, shale oil and synfuels derived from coal. There is concern about the health effects of environmental exposure to these chemicals because of the demonstrated mutagenicity or carcinogenicity of certain aza-arenes. Since aza-arenes are present as airborne pollutants, one possible route of human exposure is by inhalation. Presently, few studies exist on the absorption, distribution and elimination of these compounds when inhaled. Such information would be useful in designing long term animal toxicity studies and extrapolating the results of these studies to human exposure situations. The authors have studied the absorption, tissue distribution and elimination of radioactivity in rats after inhalation of [/sup 14/]-phenanthridone (PNDO). PNDO was chosen as a representative neutral aza-arene

because it is a bacterial mutagen and has been found in coal tar, a potential pollutant from coal gasification. PNDO asborption from the GI tract was also measured to determine if material swallowed following inhalation exposure could significantly contribute to tissue concentrations.

16157 **Quantifying benzo[a]pyrene binding to DNA by fluorescent analysis.** Shugart, L.; Rahn, R.O.; Holland, J.M. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

The cellular metabolism of benzo[a]pyrene (BaP) to the chemically reactive diolepoxides BaPDE I and BaPDE II results in the formation of covalent BaPDE-adducts with DNA which may be the initiating events responsible for the observed carcinogenic properties of BaP. The common method for quantitating the binding of BaPDE to DNA makes use of radioactively labeled BaP. However, in those instances in which the sources of BaP are substances found in the environment, it is not possible to use radiometric detection because the BaP is unlabeled. Hence, only meager estimates exist of the burden in human tissue of BaP derivates. Fluorimetry, with its intrinsically high sensitivity, is an alternative to radiometric analysis for detecting carcinogens bound to DNA. Previously, fluorescence studies of the intact BaPDE-DNA complex have utilized either photon counting or low temperature fluorimetry or a combination of these methods to detect as little as one molecule of BaPDE bound per 10/sup 5/ DNA nucleotides. However, in order to analyze the minute amounts of BaP derivatives bound to DNA of animals exposed to PAHs in the environment, more sensitive detection methods are necessary. Other workers have pointed out that the interaction of the bases in DNA covalently with BaPDE strongly quenches the fluorescence of the pyrene moiety. On the other hand, when the pyrene moiety is in the form of the free tetrol, the fluorescence quantum yield in deoxygenated solution is similar to that of pyrene itself. These results suggest that acid-induced removal of the pyrenyl moieties from DNA as tetrols, as has been demonstrated previously could be used to increase the sensitivity of the fluorescence assay.

16158 **Effects of butylated hydroxyanisole on the metabolism and mutagenic and transformation potentials of benzo[a]pyrene in cultured mammalian cells.** Chen, D.J.; Okinaka, R.T.; Strniste, G.F. (Genetics Group Life Sciences Div., Los Alamos National Lab., Los Alamos, NM (US));. pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

In the present study the authors have examined the effect of BHA on BaP metabolism in SHE cells. In addition, a SHE cell-mediated Chinese hamster ovary (CHO) cell mutagenesis and a SHE cell transformation assay have been used to study the biological effects of BHA. The authors' results indicate that BHA reduces the metabolism of BaP in SHE cells, suppresses BaP-induced mutagenicity in target CHO cells and reduces morphological transformation by BaP in SHE cells. The application of these mammalian in vitro assays should facilitate both the identification of other protective agents and reveal the mechanisms of their anticarcinogenic effects.

16159 **Effect of particle association on the biological fate of inhaled organic pollutants.** Sun, J.D.; Wolff, R.K.; Kanapilly, G.M.; McCellan, R.O. (Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, P.O. Box 5890, Albuquerque, NM (US)). pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

The quality of the air that surrounds various industrialized and urban population centers has been of concern for a number of years. Principle causes for air pollution include industrial operations burning fossil fuels and exhaust emissions from gasoline (26) and diesel-fuel powered automotive vehicles. Many health-risk related studies have been initiated which focus on the particulate emissions being released into the atmosphere and the complex mixture of organic compounds that has been found associated with particles of respirable size. Benzo(a)pyrene (BaP) is a polycyclic aromatic hydrocarbon (PAH) which is mutagenic, potentially carcinogenic in man and has been found to be associated with respirable particle pollutants in the atmosphere. These factors include the physical form of the compounds, the route of exposure, the deposition sites, the bioavailability and metabolic fate of these compounds in various tissues, and the rates at which these compounds are cleared from the body.

16160 **Effects of hydrotreatment on the composition of mutagenic fractions of a coal-derived petroleum substitute.** Buchanan, M.V.; Flanagan, J.; Rubin, I.B.; Guerin, M.R. (Bio/Organic Analysis Section, Analytical Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Polynuclear aromatic hydrocarbons: Formation, metabolism and measurement. Cooke, M.; Dennis, A.J. Columbus, OH; Battelle Press (1983). (CONF-8210100—).

From 7. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1982).

Coal- and shale-derived product oils differ from petroleum crudes by being more highly aromatic and by containing a greater quantity of heteroatomic species. Polycyclic aromatic compounds, especially those containing nitrogen, sulfur, and/or oxygen substituents, are generally responsible for the poor storage and handling properties of the oils. As a result, catalytic hydrogenation (hydrotreatment) is commonly used to improve both handling and use properties. Hydrotreatment carried out to improve the quality of the oils is known to reduce the mutagenicity of the oils as well. Studies to date implicate basic nitrogen-substituted polycyclic aromatics, such as primary amines and azaarenes, and polar substituted neutral polycyclic aromatics as being major contributors to the mutagenicities of coal- and shale-derived liquids. Classic chromatography allows most of these components to be isolated into two fractions. These two fractions from a crude synthetically-derived oil exhibit high mutagenicities, while the same fractions from a hydrotreated product of the same crude exhibit little or no mutagenic activity. In this study, the basic and neutral polar compounds of a crude coal derived liquid and three products from this crude which have been subjected to low, medium, and high severity hydrotreatment have been isolated and chemically characterized to determine whether hydrotreatment resulted in a selective reduction of a few components or a general reduction of all components.

5604 Other Environmental Pollutant Effects

16161 **(AD-A—201017/1/XAB) Radiofrequency/microwave cell absorption and action spectroscopy. Annual report, 1 September 1987-1 October 1988.** Cleary, S.F.; Liu, L.M. (Medical Coll. of Virginia, Richmond (USA). Dept. of Physiology and Biophysics). 25 Nov 1988. 22p. NTIS, PC A03/MF A01.

Dielectric properties (viz., real and imaginary components of the complex dielectric constant, and the absorption coefficient) were determined for mammalian cells and viruses over the frequency range 50- to 26,400 MHz. Dielectric properties were determined by using an open probe technique which measured the complex reflection coefficient using a Hewlett Packard 8510 network analyzer and associated data processing system. Independent variables investigated included: temperature, cell cycle, metabolic inhibitors, anesthetic agents, ionophores, and fixatives. Under certain conditions, these variables affected the dielectric properties of cells or viruses. No firm evidence of resonant-like absorption of radiofrequency radiation in cell or viral macromolecules, such as DNA, has been obtained.

16162 **(KTM/E-D—159) Biological effects and health hazards of electric and magnetic fields near high voltage transmission lines.** Hietanen, M.; Anttonen, H.; Jokela, K.; Juutelainen, J. (Tyoeterveyslaitos, Helsinki (Finland); Finnish Centre for Radiation and Nuclear Safety, Helsinki. Dept. of Nuclear Safety; Kuopio Univ. (Finland). Dept. of Physics). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). May 1988. 97p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756271/JAW.

The purpose of the literature review on electric and magnetic fields from power lines was to analyze the results of research reports, to present biophysical mechanisms of interaction, to evaluate possible health hazards and to clarify rationales of foreign safety standards. The area of the study was restricted to cover electric and magnetic fields of 50-60 Hz near power lines, and their biophysical, biological and health effects. The uperturbed electric field of a 400 kV power line at the height of an average man is 1-10 kV/m, and the magnetic flux density, respectively, is 10-40 uT. At hte distance of about 60 m, electric field strength is less than 0.1 kV/m and the magnetic flux density less than 1 uT. Electric and magnetic fields of a power line induce a weak electric field and electric currents in the exposed body. The average current density in a person standing under a 400 kV line is 1-2 mA/m/sup 2/, and the maximum value in conductive tissues 30 mA/m/sup 2/. Temporary current densities are much higher during spark discharges, which may cause cell alterations. Animal experiments and cell cultures have shown that high electric and magnetic fields affect the rate of cell growth and embryonic development. Effects on e.q. hormonal stimulation, blood compostion, reproduction and behaviour have also been reported. The findings are often contradictory, however, and their implication to human health is not known. On the basis of the reports analyzed in this literature review it seems that the electric and magnetic fields from 110-400 kV power lines do not cause health hazards during short-term exposures. The present knowledge about the long-term effects of particularly magnetic fields is, however, so scanty that exposure to strong magnetic fields should be restricted, whenever possible.

57 Health And Safety

REFER ALSO TO CITATION(S) 16002

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 15487

16163 **(LBL—26136) Theis' contribution and parallel developments in the earth sciences.** Narasimhan, T.N. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 7p. (CONF-881166—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006715/JAW.

From Symposium on advances in ground-water hydrology; Tampa, FL, USA (16 Nov 1988).

That Charles V. Theis has a unique position in the history of goundwater hydrology is well attested by this conference, which seeks to pay tribute to his memory. Theis made his noteworthy contribution on unsteady groundwater flow during a period when exciting progress was being made in many disciplines closely related to groundwater hydrology. It is therefore appropriate that we use this opportunity provided by the Theis commemoration to reflect upon the evolution of ideas in hydrogeology during a score of years extending from the early 1920s to the early 1940s. Such a reflection is worthwhile, not only to get a historical sense for the development of those ideas, but also to place the contribution of Theis in perspective with other distinguished contributions of that period.

5802 Geophysics

REFER ALSO TO CITATION(S) 14603, 15762

16164 **(PNL-SA—16268) A dynamic model for the formation of vesicular zones in ponded lava flows.** Long, P.E.; McMillan, K. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830. 32p. (CONF-881254—1). NTIS, PC A03 - OSTI. Order Number DE89005226/JAW.

From American Geophysical Union fall meeting; San Francisco, CA, USA (5 Dec 1988).

Thick (>30 m) flows of Columbia River basalt contain internal vesicular zones within otherwise dense, sparsely vesicular basalt. These zones are continuous over distances ranging from 2 to 30 km; most are characterized by abrupt transitions from vesicle-rich to vesicle-poor rock above and by gradational lower margins. The zones were formed by post-emplacement migration, coalescence, and entrapment of aqueous vapor bubbles. Under appropriate physicochemical conditions, bubbles nucleate at the lower solidification front and rise buoyantly until retarded by the higher viscosities preceding the upper solidifications front. Accumulation of bubbles against this ceiling occurs before freezing-in of the vesicles by the downward passage of the upper front. We have developed a one-dimensional dynamic model of the process of vesicular-zone emplacement by starting with the measured distribution of vesicles in a lava flow and calculating their movement according to Stokes' law as the flow is "melted" in the reverse of its solidification history. Estimates of the solidification history of the Cohassett flow were based on a previously developed cooling model. Simulated melting of the flow was accomplished by movement of the upper and lower solidification fronts in reverse time. 13 refs., 8 figs.

16165 **(SFB—151-9) FLUBEM - a boundary element program for calculating shock wave propagation in time in compressible fluids.** Antes, H.; Estorff, O. von; Steinfeld, B. (Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 151 - Tragverhalten und Tragfaehigkeit von Baukonstruktionen unter Dynamischen Einwirkungen). Apr 1988. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756626/JAW.

The purpose is the investigation of the wave propagation in compressible, non-viscous media. Therefore, based on the scalar wave equation, a time-dependent boundary integral equation, and from it a time-stepping boundary element algorithm is derived. The numerical procedure is given by the FORTRAN program FLUBEM. It is described in detail for some examples in regard to the input/output managing. Solutions of problems from earthquake engineering and of acoustics demonstrate the extent of the applicabilities.

16166 **(USGS-OFR—88-560) Location refinement of earthquakes in the southwestern Great Basin, 1931--1974, and seismotectonic characteristics of some of the important events.** Gawthrop, W.H.; Carr, W.J. (Geological Survey, Denver, CO (USA)). 1988. Contract AI08-78ET44802. 74p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006764/JAW.

Seismological records for the period 1931--1974 were examined and analyzed by modern techniques, including velocity structure inversion and application of station-phase corrections. Epicenter confidence ellipses and fault plane solutions were determined for many events. In the past, epicenters of earthquakes in the southwestern Great Basin have been mislocated by as much as 100 kilometers, or even more in one case. Improved locations for foreshocks and aftershocks, with relative errors of about 5 to 10 kilometers and absolute errors of perhaps 15 to 25 kilometers, permit closer inspection of possible relationships or coupling between some major events in the Nevada portion of the Nevada-California seismic zone. 28 refs., 27 figs.

16167 **Attention in western Nevada: Preliminary results from earthquake and explosion sources.** Hough, S.E.; Anderson, J.G.; Patton, H.J. (Scripps Inst. of Oceanography, University of California, San Diego). *Geophysical Research Letters;* **16**: No. 2, 207-210(Feb 1989).

We present preliminary results from a study of the attenuation of regional seismic waves at frequencies between 1 and 15 Hz and distances up to 250 km in Western Nevada. Following the methods of Anderson and Hough (1984) and Hough et al. (1988), we parameterize the asymptote of the high frequency acceleration spectrum by the two-parameter model. We relate the model parameters to a two-layer model for Q/sub i/ and Q/sub d/, the freuqency-independent and the frequency dependent components of the quality factor. We compare our results to previously published Q studies in the Basin and Range and find that our estimate of total Q, Q/sub t/, in the shallow crust is consistent with shear wave Q at close distances with previous estimates of coda Q (Singh and Hermann, 1983) and LgQ (Chavez and Priestley, 1986), suggesting that both coda Q and LgQ are insensitive to near-surface contributions to attenuation.

16168 **Effects of spall on regional seismograms.** Taylor, S.R.; Randall, G.E. (Lawrence Livermore National Laboratory, University of California). *Geophysical Research Letters;* **16**: No. 2, 211-214(Feb 1989).

The effects of spall on regional signals are investigated using synthetic seismograms to frequencies of 20 Hz. Depending on the scaling relationships used, it is found that spall may have an important effect on regional body waves and especially surface waves. The frequency range in which the spall effect dominates is dependent upon the characteristic times of the spallation process, but generally occurs in the frequency range of about 0.2 to 2 Hz. Because of the peaked nature of the radiated spall spectra, effects at frequencies outside the 0.2 to 2 Hz frequency range will be dominated by the explosion source. The frequency range and strength of the spall effect depend in a complicated manner upon the yield, depth of burial, near-source structure, and material strength. Uncertainties in the spall scaling relationships need to be better understood before the effects of spall on regional discrimination and yield estimation can be properly quantified. copyright American Geophysical Union 1989

16169 **What's new at Long Valley.** Goldstein, N.E.; Stein, R.S. (Lawrence Berkeley Laboratory, Berkeley, California). *Journal of Geophysical Research;* **93**: No. B11, 13187-13191(10 Nov 1988).

At few places in the conterminous United staes does magma, the raw material of the Earth's crust and mantle, appear at tantalizingly close to the surface as at Long Valley caldera in eastern California. Here the search for a site to drill into a magma chamber for the purpose of geothermal energy development coincides with a separate scientific imperative, the need to monitor the caldera for potential hazards due to earthquakes and volcanic eruptions. The region has a proven potential for these hazards: five $M \geqq 6$ earthquakes have struck since 1978, and phreatic, ash and steam, eruptions have occurred as recently as 550—600 years ago [Miller, 1985]. As we assess the results of additional intermediate depth holes and the results from a widening spectrum of divining tools, the magma seems farther from the surface and less abundant than it did just a few years ago. We have also begun to discern the profound imprint of structures which predate the formation of the caldera 0.73 Ma and which now appear to control its eruptive behavior and hydrothermal system.

16170 **Structure and stratigraphy beneath a young phreatic vent: South Inyo Crater, Long Valley caldera, California.** Eichelberger, J.C.; Vogel, T.A.; Younker, L.W.; Dan Miller, C.; Heiken, G.H.; Wohletz, K.H. (Sandia National Laboratories, Albuquerque, New Mexico). *Journal of Geophysical Research;* **93**: No. B11, 13208-13220(10 Nov 1988).

An 861-m-long hole has been cored on a slanted trajectory that passed directly beneath South Inyo Crater in the west moat of Long valley Caldera, California. The purpose of the hole was to investigate the magmatic behavior that led to surface deformation and phreatic activity during the 600-year-old eruption of the Inyo vent chain. The hole was sited 216 m southwest of the crater, passed beneath its center at a depth of 566 m, and terminated 79 m northeast of the crater center at a depth of 810 m. Metamorphic basement was encountered at a depth of 779 m. The volcanic and sedimentary sequence consists solely of post-Bishop Tuff caldera fill, including 319 m of moat basalt and 342 m of early rhyolite, and is nearly 900 m thinner than in a Unocal Corporation well 900 m to the southeast. Apparently, a major fault lies between the two holes and forms part of the western structural boundary of the caldera, 3—4 km inboard of its topographic boundary. Breccia zones that intrude the caldera fill were intersected at 12.0—9.3 m and 1.2—0.8 m SW and 8.5—25.1 m NE of the crater center.

16171 **Three-dimensional gravity modeling of the geologic structure of Long Valley caldera.** Carle, S.F. (Department of Materials Science and Mineral Engineering, Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley). *Journal of Geophysical Research;* **93**: No. B11, 13237-13250(10 Nov 1988).

A 48-mGal gravity low coincides with Long Valley caldera and is mainly attributed to low-density caldera fill. Gravity measurements by Unocal Geothermal have been integrated with U.S. Geological Survey data, vastly improving gravity station coverage throughout the caldera. A strong regional gravity trend is mainly attributed to isostasy. A "best fitting" (based on regional control of basement densities) Airy-Heiskanen isostatic model was used for the regional correction. A three-dimensional, multiple-unit gravity modeling program with iterative capabilities was developed to model the residual gravity. The density structure of Long Valley caldera and vicinity was modeled with 22 discrete density units, most of which were based on geologic units. Information from drill hole lithologies, surface geology, and structural geology interpretations constrain the model. Some important points revealed by the three-dimensional gravity modeling are that (1) the volume of ejected magma associated with the Bishop Tuff eruption is greater than previously thought, (2) the caldera structure is strongly influenced by precaldera topography and the extensions of major, active faults, (3) the main west ring fracture is coincident with the Inyo Domes—Mono Craters fracture system, (4) a relatively low-density region probably underlies the caldera, and (5) a silicic magma chamber may underlie Devils Postpile. copyright American Geophysical Union 1988

16172 **(EPRI-NP—4726-A-Rev.1-Vol.1-Pt.2) Seismic hazard methodology for the Central and Eastern United States: Volume 1: Part 2, Methodology (Revision 1): Final report.** McGuire, R.K.; Veneziano, D.; Van Dyck, J.; Toro, G.; O'Hara, T.; Drake, L.; Patwardhan, A.; Kulkarni, R.; Keeney, R.; Winkler, R. (Electric Power Research Inst., Palo Alto, CA (USA); Risk Engineering, Inc., Golden, CO (USA); Woodward-Clyde Consultants, San Francisco, CA (USA); Geomatrix Consultants, Inc., San Francisco, CA (USA); Cygna Corp., San Francisco, CA (USA)). Nov 1988. 311p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89006329/JAW.

Aided by its consultant, the US Geologic Survey (USGS), the Nuclear Regulatory Commission (NRC) reviewed "Seismic Hazard Methodology for the Central and Eastern United States." This topical report was submitted jointly by the Seismicity Owners Group (SOG) and the Electric Power Research Institute (EPRI) in July 1986 and was revised in February 1987. The NRC staff concludes that SOG/EPRI Seismic Hazard Methodology as documented in the topical report and associated submittals, is an acceptable methodology for use in calculating seismic hazard in the Central and Eastern United States (CEUS). These calculations will be based upon the data and information documented in the material that was submitted as the SOG/EPRI topical report and ancillary submittals. However, as part of the review process the staff conditions its approval by noting areas in which problems may arise unless precautions detailed in the report are observed. 23 refs.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 15099, 15100, 15480, 15507

16173 **(SKI—86004) Joint Statistics. Tunnel mapping vs. large open rooms. A Comparison. Final report.** Mathis, J.I. (Luleaa Univ. (SE). Div. of Rock Mechanics). (Swedish Nuclear Power Inspectorate, Stockholm; Hoegskolan i Luleaa (Sweden). Adv. foer Bergmekanik). 16 Nov 1987. 191p. (TULEA—1987-18). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756292/JAW.

The project was intended to determine if the fabric data obtained from joint fabric mapping of tunnels in the vicinity of a large open room could be used to predict the joint fabric within the large opaen room. Mapping was conducted at Forsmark SFR, Forsmark, Sweden. Forsmark SFR is designed to be a storage place for low and medium level nuclear waste. Located under the Baltic Sea, in a highly metamorphosed gneiss-granite complex, the repository consists of a large silo approximately 30 m in diameter and over 60m in height surrounded by excavation and storage tunnels. Three types of mapping were conducted. The tunnels were mapped by both line and area mapping techniques; the line mapping technique being relatively standard and the area mapping technique being a cell mapping technique developed during this project. The silo was mapped in conjunction with reinforcement work and consisted of mapping the longer joints encountered in the silo. Line and cell mapping give similar results for joint set orientations and joint set mean lengths. Joint set spacings differ but this difference can be explained. The statistics obtained from fabric mapping in tunnels adequately predicted the orientations of structures for the silo. Joint lengths may also be predicted. However, the comparison here indicates that joint lengths may be underestimated for the silo. This difference may also be explained. Little can be said about the adequacy of tunnel mapping to predict joint spacing within the silo due to the exclusion of joints during the mapping process.

5805 Oceanography

16174 **(DOE/ER/60354—T4) Biological processes in the water column of the South Atlantic Bight: Zooplankton responses: Progress report, June 1988--June 1989.** Paffenhoefer, G.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 7 Feb 1989. Contract FG09-85ER60354. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006828/JAW.

It is our objective to determine the major processes governing the abundance, composition and disruption of zooplankton as part of the interdisciplinary southeastern US continental shelf program of the Department of Energy. We will study the effects of physical processes such as along- and cross shelf advection and frontogenesis, on the development and fate of zooplankton populations during winter. Our proposed research consists of shipboard sampling, laboratory experiments and in situ determination of zooplankton abundance over time. The last objective represents a novel approach because the observations are (a) non-destructive with great spatial resolution, and (b) occur on current meter arrays at similar scales as measurements of current velocity and direction. Results to date show prolonged residence times of upwelled water masses on the middle and inner shelf during summer which results in the development of massive copepod and tunicate populations. During spring, the extent of displacement of nearshore zooplankton was a function of wind stress. Our results can be used to predict the impact of energy-related technology on the ecosystem of the southeastern continental shelf. 8 refs., 6 figs.

16175 **Existence of solutions to the stommel-charney model of the gulf stream.** Barcilon, V. (Geophysical Sciences, Univ. of Chicago, Chicago, IL (US)); Constantin, P. (Dept. of Mathematics, Univ. of Chicago, IL (US)); Titi, E.S. (Dept. of Mathematics, Univ. of Chicago, IL (US));. *SIAM Journal of Mathematical Analysis;* **19**: No. 6, 1355-1364(Nov 1988).

This paper discusses the existence of weak solutions to the equations as a model of the Gulf Stream. The method of artificial viscosity is also discussed. Key words: Navier-Stokes equation, artificial viscosity, ocean circulation, DOE. The authors examine the mathematical properties of an equation arising in the theory of ocean circulation. In order to understand the role of this problem in oceanography, a brief review of the subject is given. The first successful attempt to provide a mathematical description of the mid-latitude ocean currents was made by other investigators. It was shown conclusively that a Gulf Stream-like intensification on the western side of an ocean basin could be explained by the so-called β-effect. This is the geophysical terminology for the latitudinal variation of the normal component of the earth's rotation. Aside from this variable Coriolis force, the other forces which entered into Stommel's model were those due to the pressure gradient, the surface winds, and friction. For the sake of simplicity, this last force was taken to be proportional to the velocity fields. All the effects of density stratification were neglected by making the assumption that the ocean was homogeneous. Finally, by working with vertical averages, Stommel essentially treated the ocean circulation as a two-dimensional horizontal motion. Somewhat surprisingly, Stommel's ad hoc, linear model was shown later to provide an accurate description of an actual experimental setup.

64 PHYSICS I

REFER ALSO TO CITATION(S) 16406

16176 **(AERE-PR/TP—44) Theoretical Physics Division progress report. October 1986-September 1987.** (UKAEA Harwell Lab. Theoretical Physics Div.). May 1988. 166p. H.M. Stationery Office, London, price Pound 26.00.

The paper presents the Progress Report (Oct. 1986-Sept. 1987) of the Theoretical Physics Division of Harwell Laboratory, United Kingdom. The report contains a review of the work of each of the five Groups within the Division, including the solid state and quantum physics group, fuel modelling and reactor materials group, theory of fluids group, theoretical metallurgy group, and statistical physics group. (U.K.).

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 15906, 15907, 16372, 16379, 16444

16177 **(CBPF-NF—045/88) Exact solutions in Brans-Dicke theory: a dynamical system approach.** Romero, C.; Oliveira, H.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705408/JAW.

A method is furnished for constructing isotropic and homogeneous solutions in Brans-Dicke theory based on the analysis of the dynamical system formed by the field equations. Large classes of solutions found in the literature are recovered and shown to be special cases of those generated by this method.

16178 **(CBPF-NF—046/88) Quantitative analysis of cosmological models in a Brans-Dicke theory.** Romero, C.; Oliveira, H.P.; Mello Neto, J.R.T. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 82p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705409/JAW.

Isotropic and homogeneous cosmological models with a perfect fluid source in Brans-Dicke theory are investigated from the point or view of dynamical systems theory.

16179 **(DOE/ER—0403) Report of the High Energy Physics Advisory Panel (HEPAP) subpanel on high energy gamma ray and neutrino astronomy.** Gaisser, T.K.; Gordon, H.A.; Melissinos, A.; Rosen, S.P.; Ruderman, M.A.; Turner, M.S.; Zeller, M. (USDOE Office of Energy Research, Washington, DC). Nov 1988. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006929/JAW.

This report contains information on topics of neutrino and gammay-ray astronomy. Some of the topics discussed are: SN1987A, statistics and variability, background rejection and muons, relation between photon and neutrinos, sensitivity of

gamma-ray experiments, comparison of air Cherenkov experiments, air shower experiment, and underground experiments. (LSP)

16180 **(IFT-P—13/88) Quasar-galaxy associations with discordant redshifts as a topological effect. II. A closed hyperbolic model.** Fagundes, H.V. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 47p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705467/JAW.

We develope a conjecture that might solve the quasar redshift controversy by the effect of multiple image production through a non-trivial topology. (M.W.O.).

16181 **(IFT-P—18/88) Constraint on C, P and T violation in gravitation from SN1987 a data.** Almeida, L.D.; Matsas, G.E.A.; Natale, A.A. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705470/JAW.

We show that an analysis similar to the one of Longo and Krauss and Tremaine which determine limits on the equivalence principle from SN 1987 a data, can be used to constrain the existence of C, P and T violation in gravitation.

16182 (INIS-SU—68, pp 533) **/sup 129/I as a radioactive monitor of nucleosynthesis burst.** Chechev, V.P.; Kramarovskij, Ya.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16183 **(KFKI—1988-33/C) Dust photometry in the near nucleus region of comet Halley.** Szegoe, K.; Szatmary, Z.; Kondor, A.; Merenyi, E.; Toth, I.; Smith, B.A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Magyar Tudomanyos Akademia, Budapest. Csillagvizsgalo Intezete; Arizona Univ., Tucson (USA). Lunar and Planetary Lab.). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Aug 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705568/JAW.

The dust-jet radial brightness has been analyzed along jet cores on images taken by the tv experiment aboard VEGA 2 spacecraft, during the close encounter with comet Halley in 1986 March. Applying the RFIT code for fitting the data obtained it was shown that there is a breakpoint in the radial brightness distribution which occurs at about 40 km above the surface. These results are interpreted as consequences of the heat shock induced disintegration of dust particles as they are ejected into the near-nucleus environment. (R.P.) 22 refs.; 4 tabs.

16184 (N—89-13330) **Infrared observations of comets Halley and Wilson and properties of the grains.** Hanner, M.S. (National Aeronautics and Space Administration, Washington, DC (USA)). Sep 1988. 200p. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—). NTIS, PC A09/MF A01.

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The presented papers and discussions at a workshop held at Cornell Univ. are summarized. The infrared observations of Comet Halley and Comet Wilson are reviewed and they are related to optical properties and composition of cometary grains. Relevant laboratory studies are also discussed. Recommendations are made for future infrared comet observations and supporting laboratory investigations.

16185 (N—89-13330, pp 1-21) **Infrared observations of the dust coma.** Campins, H.C.; Tokunaga, A.T. (Hawaii Univ., Honolulu (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The main infrared observational results were briefly reviewed at the start of this session. The new results are summarized. All of these results have yet to be synthesized into a self-consistent picture of the dust grain composition, dust production history, outburst mechanisms, and composition of the nucleus. The workshop discussion was helpful in pointing out problems faced by theorists, such as data quality, the lack of the proper theory for computing the scattering and emission of irregular particles, and in some cases the lack of optical constants of realistic materials. It is expected that the gross spectral and dynamical properties of Halley's Comet can be understood in time, even if the details of the observations and the theoretical calculations continue to vex us in the future.

16186 (N—89-13330, pp 22-49) **Grain optical properties.** Hanner, M. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The optical properties of small grains provide the link between the infrared observations presented in Chapter 1 and the dust composition described in Chapter 3. In this session, the optical properties were discussed from the viewpoint of modeling the emission from the dust coma and the scattering in order to draw inference about the dust size distribution and composition. The optical properties are applied to the analysis of the infrared data in several ways, and these different uses should be kept in mind when judging the validity of the methods for applying optical constants to real grains.

16187 (N—89-13330, pp 50-63) **Cometary dust composition.** Gehrz, R.D.; Hanner, M.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The earth based measurements and in situ sampling of Comet Halley have provided new data about the chemical composition of cometary grains. Recent progress in laboratory studies of interplanetary dust particles (IDPs) complement the comet data, allowing inferences about the mineralogy and physical structure of the comet dust to be drawn from the observed elemental composition and infrared spectra. The in situ dust composition measurements at Halley, the composition of IDPs and their relation to comet dust, and the origin of the 3.4 micron hydrocarbon feature is discussed. Related discussion is also presented on aromatic components in comets and the 3.4 micron feature. These topics are briefly summarized.

16188 (N—89-13330, pp 64-65) **PIA update: Correlation analyses of mass spectra.** Mason, L.W.; Clark, B.C. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The PIA instrument aboard the Giotto spacecraft (a time of flight spectrometer) has been presented elsewhere. The mass spectra used in this analysis were decoded and mass numbers assigned according to the presence of carbon and silver, using the global values for these elements in their spectral absence. The results presented here were obtained using a frequency of occurrence based on analysis which correlated how often mass numbers appear in the mass spectra and which mass numbers tend to occur together in the same spectra; no amplitude information is utilized. The data are presented as plots of mass vs coincident mass for different subsets of the PIA data set, with both axes having units of atomic mass. Frequency contours are plotted at approximately five percent contour intervals, relative to the maximum AMU occurrence in that plot. The plots presented are symmetrical about the matrix diagonal, i.e., every mass is coincident with itself in a given spectra.

16189 (N—89-13330, pp 66-67) **Comparison of Halley dust with meteorites, interplanetary dust and interstellar grains.** Brownlee, D.E. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The variability of the mineral forming elements in the submicron Halley grains provides a powerful basis for comparison of Halley with the different classes of meteoritic materials that have been studied in the lab. The degree of variability in the Halley samples is larger than that seen in chondrites implying that Halley is more heterogeneous at the submicron scale. A critical distinction is that Halley contains abundant pure Mg silicates at the size scale while the carbon rich meteorites do not. The submicron dispersion composition seen in Halley is dramatically different from the narrowly constrained compositions seen in CI and CM (type 1 and 2) carbonaceous chondrites. These meteorites are carbon rich but are dominated by a hydrated silicate with a very narrow range of Mg/Si ratio. The Halley results are also unlike the composition variations seen in most of interplanetary dust types that are dominated by hydrated materials. The only known class of meteoritic material that appear to closely resemble the Halley data is a class of cosmic dust composed entirely of anhydrous minerals. The composition implies that Halley is dominated by olivine, pyroxene, iron sulfide, glass and amorphous carbonaceous matter.

16190 (N—89-13330, pp 68-72) **Spectral properties of interplanetary dust particles.** Sandford, S.A. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The observed spectral and mineralogical properties of interplanetary dust particles (IDP) allows the conclusion that: (1) the majority of IDP infrared spectra are dominated by olivine, pyroxene, or layer lattice silicate minerals, (2) to the first order the emission spectra of comets Halley and Kohoutek can be matched by mixtures of these IDP infrared types, implying that comets contain mixtures of these different crystalline silicates and may vary from comet to comet and perhaps even within a single comet, (3) do not expect to observe a single 20 micron feature in cometary spectra, (4) carbonaceous materials dominate the visible spectra properties of the IDPs even though the mass in these particles consists primarily of silicates, and (5) the particle characteristics summarized need to be properly accounted for in future cometary emission models.

16191 (N—89-13330, pp 73-74) **Aromatic components in cometary materials.** Allamandola, L.J.; Sandford, S.A.; Wopenka, B. (Washington Univ., St. Louis, MO (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Abstract Only.

The Raman spectra of interplanetary dust particles (IDPs) collected in the stratosphere show that two bands at about 1350 and 1600 delta/cm and a broader feature between 2200 and 3300 delta/cm that are characteristic of aromatic molecular units with ordered domains smaller than 25 A in diameter. This suggests that the carbonaceous material in IDPs may be similar to the polymeric component seen in meteorites, where this material is thought to consist of aromatic molecular units that are randomly interlinked by short aliphatic bridges. The features in the Raman spectra of IDPs are similar in position and relative strength to interstellar infrared emission features that have been attributed to vibrational transitions in free molecular polycyclic aromatic hydrocarbons. Taken together, these observations suggest that some fraction of the carbonaceous materials in IDPs may have been produced in circumstellar dust shells and only slightly modified in interstellar space.

16192 (N—89-13330, pp 75-78) **3.4 micrometer emission feature in Comet Halley.** Brooke, T.Y.; Knacke, R.F. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Several teams of ground based observers reported observations of the emission feature centered at 3.36 micrometers in comet Halley following its discovery by the Vega 1 spacecraft. The position and shape of the band indicate a superposition of emissions by C-H groups. But the mechanism for the excitation of these C-H3 groups is still not agreed upon. Three possibilities are summarized. Elucidation of the emission mechanism is needed to determine whether the source is predominately solid or gas. In addition, is it shown that the derived carbon abundance in Halley depends strongly on the assumed mechanism.

16193 (N—89-13330, pp 79-82) **Comparison of the 3.36 micrometer feature to the ISM.** Tokunaga, A.T.; Brooke, T.Y. (State Univ. of New York, Stony Brook (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

It has been noted that the 3.36 micrometer emission feature is not the same as that of any ISM band at 3.4 micrometer. This is documented herein. There is no convincing analog to the cometary 3.36 micrometer emission feature seen in the Interstellar Matter band. This fact suggests that if the carbonaceous material in comets came from the ISM, it was either further processed in the solar nebula or has a different appearance because of the different excitation environment of the sun and ISM.

16194 (N—89-13330, pp 83-84) **Two component model for thermal emission from organic grains in Comet Halley.** Chyba, C.; Sagan, C. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

observations of comet Halley in the near infrared reveal a triple-peaked emission feature near 3.4 micrometer, characteristic of C-H stretching in hydrocarbons. A variety of plausible cometary materials exhibit these features, including the organic residue of irradiated candidate cometary ices (such as the residue of irradiated methane ice clathrate, and polycyclic aromatic hydrocarbons. Indeed, any molecule containing -CH3 and -CH2 alkanes will emit at 3.4 micrometer under suitable conditions. Therefore tentative identifications must rest on additional evidence, including a plausible account of the origins of the organic material, a plausible model for the infrared emission of this material, and a demonstration that this conjunction of material and model not only matches the 3 to 4 micrometer spectrum, but also does not yield additional emission features where none is observed. In the case of the residue of irradiated low occupancy methane ice clathrate, it is argued that the lab synthesis of the organic residue well simulates the radiation processing experienced by Comet Halley.

16195 (N—89-13330, pp 85) **Carbon abundance in Comet Halley derived from the 3 micron feature: Comparison with interstellar dust.** Encrenaz, T.; Puget, J.L.; Dhendecourt, L. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

In spite of some similarities with the infrared features observed in the interstellar medium, the 3 micron signature observed in comet Halley's spectrum shows two distinct differences: (1) the 3.28 micron and 3.37 micron cometary features are both in emission, while the 3.37 micron interstellar feature is most often observed in absorption; and (2) there is no associated emission feature beyond 6 micron in the cometary spectrum. These two facts can be simply explained if it is assumed that the excitation mechanism is resonance fluorescence by the solar IR radiation field. With this assumption, it is found that hydrocarbons are present in roughly equal quantities in both the saturated forms, with a total carbon abundance of about 30 percent of H2O. This carbon abundance can be compared with the abundances derived for the interstellar dust when all condensed (or condensable) components are considered.

16196 (N—89-13330, pp 86-90) **Possible identifications of the 3.4 micrometer feature.** Danks, A.C.; Lambert, D.L. (Texas Univ., Austin (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

A feature at 3.4 micrometers was first detected in Comet Halley by the IKS spectrometer on board the Vega 1 probe; and subsequently from the ground. The feature has since been reported

in Comet Wilson. The presence of the feature is of considerable interest for a number of reasons. First, it may represent the detection of a new parent molecule, and when combined with data from Giotto and Vega yield new information on cometary chemistry and the early solar system composition. Secondly, it may represent a link to the interstellar medium, the feature corresponds in wavelength and shape with an interstellar feature seen in absorption in a luminous star, towards the Galactic center known as GC-IRS7. The feature in turn is thought to be related with a growing family of unidentified infrared emission features seen in stellar objects, planetary nebulae, reflection nebulae, HII regions and extra galactic sources. These features occur at wavelengths 3.3, 3.4, 3.5, 6.2, 7.7, 8.6, and 11.25 micrometers. Further identification theory is given.

16197 (N—89-13330, pp 91-104) **Laboratory investigations.** Russell, R.W. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Laboratory studies related to cometary grains and the nuclei of comets can be broken down into three areas which relate to understanding the spectral properties, the formation mechanisms, and the evolution of grains and nuclei: (1) Spectral studies to be used in the interpretation of cometary spectra; (2) Sample preparation experiments which may shed light on the physical nature and history of cometary grains and nuclei by exploring the effects on grain emissivities resulting from the ways in which the samples are created; and (3) Grain processing experiments which should provide insight on the interaction of cometary grains with the environment in the immediate vicinity of the cometary nucleus as the comet travels from the Oort cloud through perihelion, and perhaps even suggestions regarding the relationship between interstellar grains and cometary matter. A summary is presented with a different view of lab experiments than is found in the literature, concentrating on measurement techniques and sample preparations especially relevant to cometary dust.

16198 (N—89-13330, pp 105-116) **Focus on the future.** Hanner, M.S. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

An assessment is made of what was learned from Halley and recommendations are made for future directions for infrared studies of comets and supporting lab investigations. The following issues are addressed: (1) What steps can be taken to achieve consistent interpretation of Halley infrared data; (2) How successful has the Halley Watch been for infrared studies; (3) What supporting lab research is needed; (4) What are the key infrared observations needed for future comets; and (5) How do current and future NASA programs relate to comet studies.

16199 (N—89-13330, pp 117-122) **Current status of the international Halley Watch infrared net archive.** McGuinness, B.B. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The primary purposes of the Halley Watch have been to promote Halley observations, coordinate and standardize the observing where useful, and to archive the results in a database readily accessible to cometary scientists. The intention of IHW is to store the observations themselves, along with any information necessary to allow users to understand and use the data, but to exclude interpretations of these data. Each of the archives produced by the IHW will appear in two versions: a printed archive and a digital archive on CD-ROMs. The archive is expected to have a very long lifetime. The IHW has already produced an archive for P/Crommelin. This consists of one printed volume and two 1600 bpi tapes. The Halley archive will contain at least twenty gigabytes of information.

16200 (N—89-13330, pp 127-128) **Interstellar grain chemistry and the composition of comets.** Allamandola, L.J.; Sandford, S.A.; Valero, F.P.J. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

During the past 15 years considerable progress in observational techniques has been achieved in the middle infrared, the spectral region most diagnostic of molecular vibrations. Spectra of many different astronomical infrared sources are now available. By comparing these astronomical spectra with the spectra of lab ices, one can determine the composition and abundance of the icy materials frozen on the cold dust grains present in the interior of molecular clouds. In the experiments described, the assumption is made that cometary ices are similar to interstellar ices. As an illustration of the processes which can take place as an ice is irradiated and subsequently warmed, the infrared spectra is presented of the mixture H2O:CH3OH:CO:NH3:C6H14 (100:50:10:10:10). Apart from the last species, the ratio of these compounds is representative of the simplest ices found in interstellar clouds.

16201 (N—89-13330, pp 129-133) **Spectral appearance of comets from 5 to 20 micrometers: A survey of the data.** Bregman, J.D. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Based on the concept of comets as being conglomerates of rocks and ices, it is expected that they reflect these components in their emission spectra. Silicate materials (rocks) are common in many astronomical environments and show prominent features at about 10 and 18 micrometers. Carbon should be abundant, but is much more difficult to detect spectroscopically since it has no strong features (except for the hydrogenated form). Ices are present in comets, but they are difficult to detect since they are volatile enough to dissipate when the comet is bright enough to be easily observed in the IR, with present equipment. There are other materials present in comets, but the ones listed above should be the most common and thus dominate the thermal IR spectrum. Most of the IR observations made on comets between 5 and 20 micrometers are summarized. They fall into three broad categories: (1) filter photometry; (2) circular variable filter wheel spectroscopy; and (3) spectra obtained with multidetector grating spectrometers.

16202 (N—89-13330, pp 134-135) **Near-infrared polarization and color of Comet Halley: What can we learn about the grains.** Brooke, T.Y.; Knacke, R.F. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The near infrared polarization and JHK colors of light scattered by dust grains in comet Halley were measured over a wide range in phase angle and heliocentric distance. Colors were redder than solar with no statistically significant variation with phase angle, heliocentric distance, or pre- and post-perihelion. This suggests that the grain population did not change drastically over time and that the data may be combined and modeled. However, short term variations in visible polarization and dust albedo were seen in Halley. Also, near infrared colors became systematically bluer after the observations were completed. The near infrared colors of Halley fall in the range of those of other comets. The near infrared polarization is similar to the visible polarization of Halley and other comets in showing a negative branch at small phase angles and an approximately linear rise toward positive values at larger phase angles. Mie theory calculations and a size distribution based on spacecraft data were used to model the near infrared polarization and color of comet Halley. Numerous lines of evidence point to the presence of dark, absorbing, probably carbonaceous materials in comets.

16203 (N—89-13330, pp 137-138) **Cometary dust size distributions from flyby spacecraft.** Divine, N. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Pior to the Halley flybys in 1986, the distribution of cometary dust grains with particle size were approximated using models which provided reasonable fits to the dynamics of dust tails, anti-

tails, and infrared spectra. These distributions have since been improved using fluence data (i.e., particle fluxes integrated over time along the flyby trajectory) from three spacecraft. The fluence derived distributions are appropriate for comparison with simultaneous infrared photometry (from Earth) because they sample the particles in the same way as the IR data do (along the line of sight) and because they are directly proportional to the concentration distribution in that region of the coma which dominates the IR emission.

16204 (N—89-13330, pp 139-141) **Polarization images of Comet Halley.** Eaton, N.; Scarrott, S.M.; Warren-Smith, R.F. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Observations from two dates 5 Jan. and 7 Jan. 1986 are presented. The images were obtained with the Durham imaging polarimeter on the 1-m telescope of the Wise Observatory, Israel. The observations were made through a broadband filter centered at 0.67 microns with a 0.17 micron effective bandwidth. This wavelength region should be dominated by continuum radiation. The intensity images cover 46 x 78 arcsecs. The intensity images are shown in logorithmic form and they are analyzed.

16205 (N—89-13330, pp 142-144) **Detection of parent molecules in the IR spectrum of P/Halley with the IKS-Vega spectrometer.** Encrenaz, T.; Crovisier, J.; Combes, M.; Moroz, V.I.; Grigoriev, A. (Academy of Sciences, Moscow (USSR)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The two spectroscopic channels of the IKS experiment on board the Vega probes were designed for the detection of emission bands of parent molecules and/or cometary dust, in the 2.5 to 5 micrometer range and the 6 to 12 micron range respectively. On Vega 1, the experiment worked successfully, and cometary spectra were recorded at distances from the comet nucleus ranging from about 250,000 to 40,000 km. The field of view was 1 deg and the spectral resolving power was about 50. On Vega 2, no result could be obtained due to a failure of the cryogenic system. The emission spectra obtained are briefly analyzed.

16206 (N—89-13330, pp 145-146) **Infrared observations of P/Halley and P/Encke.** Gehrz, R.D.; Ney, E.P. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Broadband optical/infrared photometers responding from 0.5 to 23 microns mounted on the Univ. of Minnesota (UM) O'Brien 76-cm telescope, Wyoming Infrared Observatory 234-cm telescope, and UM's Mount Lemmon Infrared Observatory 152-cm telescope were used to measure comet Halley more than 30 times between 12 Dec. 1985 to 6 May 1986. The Wyoming system was used to measure P/Encke on 24 Jul. 1987. The equipment and observations of Halley were fully described by Gehrz and Ney. Conclusions based on a preliminary analysis of the Halley and P/Encke data are reported.

16207 (N—89-13330, pp 147-149) **Airborne 20-65 micron spectrophotometry of Comet Halley.** Glaccum, W.; Moseley, S.H.; Campins, H.C.; Loewenstein, R.F. (Yerkes Observatory, Williams Bay, WI (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

observations of comet Halley with a grating spectrometer on board the Kuiper Airborne Observatory on four nights in Dec. 1985 to Apr. 1986 are reported. Low resolution 20 to 65 micrometer spectra of the nucleus with a 40 arcsec FWHM beam was obtained on 17 Dec. 1985, and on 15 and 17 Apr. 1986. On 20 Dec. 1985, only a 20 to 35 micrometer spectrum was obtained. Most of the data have been discussed in a paper where the continuum was dealt with. In that paper, models were fit to the continuum that showed that more micron sized particles of grain similar to amorphous carbon were needed to fit the spectrum than were allowed by the Vega SP-2 mass distribution, or that a fraction of the grains had to be made out of a material whose absorption efficiency fell steeper than lambda sup -1 for lambda greater than 20 micrometers. Spectra was also presented taken at several points on the coma on 15 Apr. which showed that the overall shape to the spectrum is the same in the coma. Tabulated values of the data and calibration curves are available. The spectral features are discussed.

16208 (N—89-13330, pp 151-153) **Albedo map of P/Halley on 13 March 1986.** Hayward, T.L.; Grasdalen, G.L.; Green, S.F. (Kent Univ., Canterbury (England)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

An albedo map is presented of comet Halley from a 10 micrometer image taken from the Wyoming Infrared Observatory on 13 Mar. 1986, and a 7311 A CCD image taken from the Anglo-Australian Telescope about an hour later. To construct this map, the CCD image was first converted from 0.49 arcsec/pixel to 1 arcsec/pixel to match the scale of the 10 micron image, then both were calibrated in lambda F sub lambda units. According to the albedo map, most of the inner coma of Halley lies between gamma = 0.04 and 0.08. The overall smoothness of the map is remarkable considering the large dynamic range of the optical and IR maps, and the differences in spatial resolution and image processing.

16209 (N—89-13330, pp 154-155) **Problem of clustering in laboratory studies of cometary dust.** Huffman, D.R. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

In trying to understand the nature of interstellar or interplanetary dust grains it is tempting to simply rely on direct lab measurements of grain properties such as extinction. However, until agreement is achieved between directly measured extinction and the same property calculated from measured optical constants of the solid, application to astronomical observations is questionable. There are two major problems which are discussed: the problem of what optical constants to use in the calculation, and the almost unavoidable problem of particle clustering in lab studies. Regarding small particle measurements, a problem afflicting almost all lab measurements is the clustering of particles. Having failed in efforts to isolate particles, the solution to the problem was attempted with a simple theory which seems to adequately describe the extinction by small, clustered particles in many cases. The theory is briefly explained.

16210 (N—89-13330, pp 156-157) **Light scattering of large rough particles application to cometary grains.** Lamy, P.L.; Perrin, J.M. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

While the electromagnetic field scattered by a spherical particle is classically obtained by the Helmholtz equation, the general case of an arbitrary particle may be investigated in the general framework of the interaction of a wave with a scattering potential. A wave function then satisfies the Schroedinger equation. The general solution of the Schroedinger equation is given. The main disadvantage of this approach are its restriction to large particles and its scalar nature preventing the calculation of the polarization. However, Perrin and Lamy have shown how to avoid the second limitation and retrieve a vectorial description. They proved that in the case of large spheres when the ad hoc assumptions are satisfied, the expression of the scattering amplitude may be approximated by an expansion series in partial waves, i.e., on a discrete basis. The analogy may be generalized, and the ratio of the two components for a rough particle obtained by taking the ratio of the reflectivities for the two directions of polarization. These reflectivities involve the simple and double reflections calculated following the method developed by Wolff for rough surfaces. The theory is further detailed.

16211 (N—89-13330, pp 158-160) **Thermal properties of heterogeneous grains.** Lien, D.J. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Cometary dust is not spherical nor homogeneous, yet these are the assumptions used to model its thermal, optical, and dynamical properties. To better understand the effects of heterogeneity on the thermal and optical properties of dust grains, the effective dielectric constant for an admixture of magnetite and a silicate were calculated using two different effective medium theories: the Maxwell-Garnett theory and the Bruggeman theory. In concept, the MG theory describes the effective dielectric constant of a matrix material into which is embedded a large number of very small inclusions of a second material. The Bruggeman theory describes the dielectric constant of a well mixed aggregate of two or more types of materials. Both theories assume that the individual particles are much smaller than the wavelength of the incident radiation. The refractivity for a heterogeneous grain using the MG theory is very similar to the refractivity of the matrix material, even for large volume fractions of the inclusion. The equilibrium grain temperature for spherical particles sized from .001 to 100 microns in radius at 1 astronomical unit from the sun was calculated. Further explanation is given.

16212 (N—89-13330, pp 161-164) **Comet Halley's colorful outbursts.** Lynch, D.K.; Russell, R.W. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Two preperihelion outbursts by Comet Halley were observed, each showing different brightness changes at 2.3, 3.6, 4.6 and 10.3 micrometers. Neither event was observed from beginning to end. The first observation on 8 Nov. 1985 lasted on the order of a day and was accompanied by a tail-like appendage recorded photographically. During the outburst the IR colors changed dramatically, showing no significant change at 10.3 micrometers but showing progressively more change at shorter wavelengths over a time scale of a few hours. The second outburst measurement extended over several days (10 to 13 Jan. 1986) during which time the intensities at the four wavelengths increased by roughly the same amount. Although the outbursts were of different duration, the IR measurements suggest that the first event involved volatile ice particles that evaporated, while the second was associated with long lived nonvolatile dust grains.

16213 (N—89-13330, pp 165) **Some 5-13 micrometer airborne observations of Comet Wilson 1986l: preliminary results.** Lynch, D.K.; Russell, R.W.; Witteborn, F.C.; Bregman, J.D.; Rank, D.M.; Cohen, M.C; Campins, H.C. (Planetary Science Inst., Tucson, AZ (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Comet Wilson was observed from the Kuiper Airborne Observatory approximately 23.6 and 25.7 Apr. 1987, UT (approx. 3 to 5 days after perihelion) using the NASA-Ames Faint Object Grating Spectrometer. Spectrophotometric data were observed with a 21 inch aperture between 5 and 13 micrometer and with a spectral resolution of 50 to 100. Spectra of the inner coma and nucleus reveal a fairly smooth continuum with little evidence of silicate emission. The 5 to 8 micrometer color temperature of the comet was 300 + or - 15 K, approx. 15 percent higher than the equilibrium blackbody temperature. All three spectra of the nucleus show a new emission feature at approx. 12.25 micrometer approx. two channels (.22 micrometer) wide. Visual and photographic observations made during the time of these observations showed a broad faint, possible two component tail. No outburst activity was observed.

16214 (N—89-13330, pp 166-171) **Aerodynamic properties of fractal grains: implications for the primordial solar nebula.** Meakin, P.; Donn, B. (Du Pont de Nemours, E. I. and Co., Wilmington, DE (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Under conditions in the primordial solar nebula and dense interstellar clouds, small grains have low relative velocities. This is the condition for efficient sticking and formation of fractal aggregates. A calculation of the ratio of cross section, sigma, to number of primary particles, N, for fractal clusters yielded ln sigma/N = 0.2635 + 0.5189N sup (-0.1748). This ratio decreases slowly with N and approaches a constant for large N. Under the usual assumption of collisions producing spherical compact, uniform density aggregates, sigma/N varies as N sup -1/3 and decreases rapidly. Fractal grains are therefore much more closely coupled to the gas than are compact aggregates. This has a significant effect on the aerodynamic behavior of aggregates and consequently on their evolution and that of the nebula.

16215 (N—89-13330, pp 172-173) **Color gradients in the coma of P/Halley.** Meech, K. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Some important information relevant to the understanding of the gas/dust dynamics near the surface of a comet nucleus concerns knowledge of the grain composition and scattering properties as well as the particle size distribution of dust in the coma. Ground based measurements of light scattered from the dust comae can provide some information about the physical grain properties, in particular about the mean optically dominant grain size. Optical spectra of continua of nine comets presented by Jewitt and Meech, 1986, show that all of the scattered light is reddened with respect to the Sun. There is significant scatter in the amount of reddening seen for different comets. In the near IF regions, the reddening decreases until near 2 to 3 micrometers where the reflectivity is nearly neutral. It is of particular interest to see if there are any observable changes in the grain size distribution during outburst. Although no coma colar changes were observed during the Nov. 1985 outbursts, a color gradient within the coma has been observed in Halley. Radial color gradients in J, H, and K images of Halley as reported by Campins have not been observed by the author.

16216 (N—89-13330, pp 175-177) **Optical properties of cometary grains.** Mukai, T. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

An analysis of visible/near IF polarimetry of Comet Halley leads to a variation of the complex refractive index m = n - i x k of grain material with wavelength, i.e., a slight decrease of n from 1.39 at lambda = 0.37 micrometer to 1.37 at lambda = 2.2 micrometers, in constrast to an increase of k from 0.024 at lambda = 0.37 micrometer to 0.042 at lambda 2.2 micrometers. The mass distribution of grains reported by Mazets et al. from in situ measurements of Vega 2 was applied in the analysis. Combining these optical constants with those of astronomical silicate proposed by Draine, cometary silicate is presented as a candidate for cometary grains. The complex refractive index of the proposed cometary silicate is shown. Based on Mie theory, an emission coefficiency of each of the grains in computed as well as its temperature, as functions of grain radius and sun comet (grain) distance. It is found that the tentative thermal spectrum from these cometary silicates, where the mass distribution of grains reported by Mazets from Vega 2 was applied, fits very well to the IR spectrum of Comet Halley. This means that cometary silicate can explain not only the phase angle and wavelength dependences of visible/near IF polarization, but also the thermal emission.

16217 (N—89-13330, pp 178-180) **Possible explanation for the inconsistency between the Giotto grain mass distribution and ground-based observations.** Perry, C.H.; Green, S.F.; McDonnell, J.A.M. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Giotto measured the in situ Halley dust grain mass distribution with 2 instruments, Particle Impact Analyzer and Dust Impact Detection System (DIDSY), as well as the total intercepted mass from the deceleration of the spacecraft (Giotto Radio-Science Experiment, GRE). Ground based observations made shortly before encounter have fluxes much higher than would be predicted from Giotto data. It is concluded that Giotto DIDSY and GRE data represent observations of dust originating from a narrow track along the nucleus. They are consistent with ground based data, if assumptions are made about the level of activity along this track. The actual size distribution that should be used for modeling of the whole coma should not include the large mass excess actually observed by Giotto. Extrapolation of the small grain data should be used, since for these grains the velocity dispersion is low and temporal changes at the nucleus would not affect the shape of the mass distribution.

16218 (N—89-13330, pp 181) **Properties of interstellar dust in reflection nebulae.** Sellgren, K. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

Observations of interstellar dust in reflection nebulae are the closest analog in the interstellar medium to studies of cometary dust in our solar system. The presence of a bright star near the reflection nebula dust provides the opportunity to study both the reflection and emission characteristics of interstellar dust. At 0.1 to 1 micrometer, the reflection nebula emission is due to starlight scattered by dust. The albedo and scattering phase function of the dust is determined from observations of the scattered light. At 50 to 200 micrometers, thermal emission from the dust in equilibrium with the stellar radiation field is observed. The derived dust temperature determines the relative values of the absorption coefficient of the dust at wavelengths where the stellar energy is absorbed and at far infrared wavelengths where the absorbed energy is reradiated. These emission mechanisms directly relate to those seen in the near and mid infrared spectra of comets. In a reflection nebula the dust is observed at much larger distances from the star than in our solar system, so that the equilibrium dust temperature is 50 K rather than 300 K. Thus, in reflection nebulae, thermal emission from dust is emitted at 50 to 200 micrometer.

16219 (N—89-13330, pp 182-183) **Laboratory simulations of comet surfaces.** Stephens, J.R.; Gustafson, B.A.S. (Florida Univ., Gainesville (USA)). Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

The geometric albedos of frozen mixtures consisting of colloidal silica and carbon black mixed with water have been measured over the wavelength range of 400 to 800 nm to compare with recent observations of Comet Halley. Data were obtained as a function of sample temperature, scattering angle, and wavelength as the frozen samples warmed to 0 C in vacuum. Scattering from water ice, flat black paint, and Kodak white reflectance paint were also measured. Lab simulations show that the change in albedo of the samples show that sublimation of the water from the sample surface can have a major effect on the albedo of a particle/ice sample in the visible. Such processing may have a marked effect on the visible albedo of comet surfaces as well.

16220 (N—89-13330, pp 184-185) **Multicomponent model of the infrared emission from Comet Halley.** Swamy, K.S.K.; Sandford, S.A.; Allamandola, L.J.; Witteborn, F.C.; Bregman, J.D. Sep 1988. NTIS, PC A09/MF A01. (NASA-CP—3004; NAS—1.55:3004; CONF-8708318—).

From Infrared observations of Comets Halley and Wilson and properties of the grains; Ithaca, NY, USA (10 Aug 1987).

A model based on a mixture of coated silicates and amorphous carbon grains produces a good spectral match to the available Halley data and is consistent with the compositional and morphological information derived from interplanetary dust particle studies and Halley flyby data. The dark appearance of comets may be due to carbonaceous coatings on the dominant (by mass) silicates. The lack of a 10 micrometer feature may be due to the presence of large silicate grains. The optical properties of pure materials apparently are not representative of cometary materials. The determination of the optical properties of additional silicates and carbonaceous materials would clearly be of use.

16221 (PPPL—2591) **An analytic treatment for a model of superclustering in the universe.** Kulsrud, R.M.; Cowley, S.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 45p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006869/JAW.

Recently, Weinberg, Ostriker, and Dekel (WOD) have proposed a model of many spherical explosions which reproduces the large scale structure of the universe quite well. Because of the success of the model, we have developed an analytic treatment which gives the cluster-cluster correlation function and the cluster mass distribution in terms of the distribution of radii of the spherical voids. We also derive an expression for the distribution in terms of the cluster mass distribution. Thus, the cluster-cluster correlation function is given in terms of the cluster mass distribution function. The numerical results of WOD agree quite well with the predictions from the observed mass distribution. We give the cluster-cluster correlation function for several model distributions of radii. This formulation should be useful for future comparisons of observation and the model of WOD. 4 refs., 5 figs.

16222 (RAL—88-082) **Low mass photinos and supernova 1987a.** Ellis, J.; Olive, K.A.; Sciama, D.W.; Sarkar, S. (European Organization for Nuclear Research, Geneva (Switzerland); Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy; International School of Advanced Studies, Trieste (Italy); Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). (Rutherford Appleton Lab., Chilton (UK)). Oct 1988. 13p. (CERN-TH—5122/88). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705585/JAW.

Photinos or higgsinos with mass 0(100) eV are not excluded by cosmological considerations, and their radiative decays could be responsible for the surprisingly large ultraviolet background recently detected at a redshift $z \sim 4$. The agreement of the neutrino data from supernova 1987a with standard expectations severely restricts the energy which could have been emitted via such light photinos or higgsinos, and hence constrains the parameters of models in which they appear. In the low mass photino case, we find that squark masses between $\sim$60 GeV and $\sim$2.5 TeV are excluded. This together with laboratory limits excludes the range of squark masses generally favoured by naturalness arguments. In the low mass higgsino case, we exclude much of the range of ratios of Higgs v.e.v.'s favoured by most models.

16223 **What can we understand about the muon anomalies in high-energy showers from point sources?.** Collins, J.; Kaidalov, A.; Khodjamirian, A.Y.; McLerran, L. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1318-1329(1 Mar 1989).

We consider here the muon anomalies which have been claimed to be seen in high-energy air showers arising from point sources. We discuss what type of particle would be required to explain the experimental data and propose a generic class of models which can explain the data. Then we discuss accelerator-experiment limits on the existence of such a particle. In particular, we argue that such a particle need not have been seen yet in either neutrino experiments or in beam-dump experiments. We argue that neutrino experiments at 800 GeV provide perhaps the most sensitive test of our hypothesis in accelerator experiments. We present distinctive features of our model which should be observable in cosmic-ray ex-

periments. Finally we discuss the problem of making an acceptable flux of cygnets at the compact x-ray source.

16224 **Case for neutrinos from SN 1987A.** LoSecco, J.M. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review [Section] D: Particles and Fields;* **39**: No. 4, 1013-1019(15 Feb 1989).

A case is made for the observation of both neutrinos and antineutrinos in the burst observed from SN 1987A. The angular distribution and energetics support this hypothesis. The experiments have good agreement with each other and with the hypothesis of a 25% forward-scattering component of the form expected from $\nu e \rightarrow \nu e$. The nature of the forward-scattering component can be inferred from known cross sections and experimental expectations. The flux and energy output in various neutrino types can be estimated. A total energy in the range of 5—8 x 10/sup 53/ ergs seems needed. This result has implications for models of supernova and for neutrino physics itself.

16225 **Axions and SN 1987A.** Burrows, A.; Turner, M.S.; Brinkmann, R.P. (Departments of Physics and Astronomy, University of Arizona, Tucson, Arizona 85721). *Physical Review [Section] D: Particles and Fields;* **39**: No. 4, 1020-1028(15 Feb 1989).

We consider the effect of free-streaming axion emission on numerical models for the cooling of the newly born neutron star associated with SN 1987A. We find that for an axion mass of greater than ~10/sup -3/ eV, axion emission shortens the duration of the expected neutrino burst so significantly that it would be inconsistent with the neutrino observations made by the Kamiokande II and Irvine-Michigan-Brookhaven detectors. However, we have not investigated the possibility that axion trapping (which should occur for masses $\geqq$0.02 eV) sufficiently reduces axion emission so that axion masses greater than ~2 eV would be consistent with the neutrino observations.

16226 **New signatures for dark-matter detectors.** Krauss, L.M.; Romanelli, P. (Center for Theoretical Physics, Sloane Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review [Section] D: Particles and Fields;* **39**: No. 4, 1225-1228(15 Feb 1989).

A new direct signal results, because of capture by Earth, if weakly interacting massive particles (WIMP's) compose the galactic-halo dark matter. The scattering signal from trapped particles can exceed that of halo WIMP's by up to four orders of magnitude, depending on Earth's interior temperature, if energy thresholds in the 10—30-eV range can be attained. However, the indirect signal due to annihilations of trapped particles is suppressed compared to previous estimates. Finally we drastically revise estimates of the direct halo signal due to WIMP's with spin-dependent cross sections, based on recent European Muon Collaboration deep-inelastic scattering data.

16227 **Limits to the radiative decays of neutrinos and axions from γ-ray observations of SN 1987A.** Kolb, E.W.; Turner, M.S. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510-0500). *Physical Review Letters;* **62**: No. 5, 509-512(30 Jan 1989).

Using γ-ray observations made by the Solar Maximum Mission Gamma Ray Spectrometer in the energy range 4.1—6.4 MeV we limit the possible radiative decays of neutrinos and axions emitted by SN 1987A. For neutrinos less massive than about 20 eV our constraint is tau/sub ν//m/sub ν/approx. $>1.7 \times 10^{15}$ B/sub γ/sec/eV; for masses between 20 and 100 eV, tau/sub ν//3.4×10^{16} B/sub γ/γ/sub GRS//sup -1/2/ sec; and for masses between 100 eV and a few MeV, tau/sub ν/m/sub ν/approx. $>8.4 \times 10^{17}$ B/sub γ/ sec eV. Here B/sub γ/ is the branching ratio for the radiative decay mode and γ/sub GRS/ is yet to be determined from the data, but should be of order unity. The axion mass limit is m/sub a/ approx. <55γ/sub GRS//sup 11/94/ eV.

16228 **Effective-action model for the vanishing of the cosmological constant.** Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review Letters;* **62**: No. 4, 373-375(23 Jan 1989).

I given an effective-action model for the vanishing of the cosmological constant, based on the qualitative ansatz that the intermediate-energy gravitational action has a nonlinear dependence on the space-time volume. This ansatz scales consistently into the infrared, and by straightforward functional-integral methods implies the vanishing of the physical cosmological constant.

16229 **Extended inflationary cosmology.** La, D.; Steinhardt, P.J. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* **62**: No. 4, 376-378(23 Jan 1989).

We present a new type of inflationary scenario based on metric formulations of gravity different from that of Einstein, e.g., Brans-Dicke theory of gravity. Unlike previous inflation models, the inflationary phase transition can be completed via bubble nucleation. Hence, the fine tuning of an effective potential to obtain a slow-rollover transition is not required.

16230 **Large-scale microwave background anisotropy in decaying particle cosmology.** Panek, M. (NASA/Fermilab Astrophysics Center, Batavia, IL (USA)). *Astrophysical Journal;* **334**: 1-5(Nov 1988).

The quadrupole anisotropy of the microwave background radiation in cosmological models with decaying particles is investigated. A conservative upper limit on value of the quadrupole moment combined with other constraints gives an upper limit on the redshift of the decay z(d) of less than 3-6. 15 references.

16231 **G70.68 + 1.2 - a pre-main-sequence star with a bright optical and radio emission shell.** Becker, R.H.; Fesen, R.A. (California Univ., Davis (USA); Lawrence Livermore National Lab., CA (USA); Colorado Univ., Boulder (USA)). *Astrophysical Journal;* **334**: L35-L40(Nov 1988).

CCD optical spectra and interference filter images of the Galactic radio source G70.68 + 1.2 are presented. These data show it to consist of a bright, shock-excited emission shell surrounding an H-alpha emission star having properties like those observed in some pre-main-sequence stars. The emission shell's eastern rim closest to this star is dominated by a reflection nebula. The optical spectra of the shell, and of two faint emission knots located 20 arcsec to the southwest, show relative line intensities similar to those seen in Herbig-Haro objects. Based on these optical data along with published infrared and radio data, it is found that G70.68 + 1.2 is not a young SNR or compact H II region as has been proposed, but instead, it is suggested that it is a massive pre-main-sequence star having associated optical nebulosity and an exceptionally strong radio flux. 25 references.

6402 Atmospheric Physics

16232 (INIS-SU—69, pp 9-11) **Simulation of direct muon generation in cosmic rays in dense matter.** Dremin, I.M.; Vavilov, Yu.N.; Madigozhin, D.T. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.

In Experimental and theoretical physics. Collection.

The Monte-Carlo method has been used to simulate the cascades of extensive air showers caused by hadrons with the energy above 2 TeV in the lead calorimeter. The production of muon pairs in the cascade is simulated through the generation of charged particles. The estimates of cross section of charm production at the energies above 2 TeV are obtained.

16233 **(INPE—4400) Time-variations of X-ray fluxes at the south atlantic magnetic anomaly in association with a strong geomagnetic storm.** Pinto Junior, O.; Gonzales, W.D.; Gonzalez, A.L.C. de. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Sep 1987. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705536/JAW.

This paper describes the temporal characteristics of the X-ray fluxes measured by a ballon-borni scintillation detector on April 14, 1981, due to electron precipitation at the South Atlantic Mag-

netic Anomaly and in association with a strong geomagnetic storm. (M.W.O.).

16234 **(UCRL—99562) Three-dimensional numerical modeling of smoke injection from large fires in the early post-nuclear-exchange environment.** Bradley, M.M.; Peterson, K.R.; Rodriguez, D.J. (Lawrence Livermore National Lab., CA (USA)). 17 Nov 1988. Contract W-7405-ENG-48. 5p. (CONF-8810286—1). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89005651/JAW.

From Cloud impacts on DOD Operations and Systems workshop; White Oak Silver Spring, MD, USA (18 Oct 1988).

During the hours immediately following a nuclear exchange, large fires could inject enormous quantities of smoke into the atmosphere. This smoke, together with dust from surface bursts, would severely restrict visibilities and darken the skies over large areas for days. This, in turn, could impact surface and air operations and systems. These effects could be mitigated by various scavenging mechanisms within the convective clouds that form above the fires. In order to evaluate impacts of post-nuclear-exchange smoke injection, we are developing a three-dimensional numerical smoke plume model (OCTET) to simulate the dynamics and microphysical processes within smoke plumes and convective clouds above large fires. This model is based on the dynamic framework of the Klemp-Wilhelmson (1978) convective storm model and includes parameterizations of scavenging processes. In addition, we are combining results of laboratory research, field experiments, and detailed numerical modeling of cloud microphysical processes in order to better understand smoke scavenging mechanisms. In this brief demonstration of capabilities, we present results from the OCTET model and from a three-dimensional mesoscale model. The smoke plume and fire-induced cloud simulations demonstrate the effects of nucleation scavenging, seasonal variation of atmospheric stability, and various fuel sources. The mesoscale simulations (that use the plume model output as input) demonstrate the mesoscale transport and diffusion of smoke and predict optical depths over the hypothetical target area. No dust effects have been included in these simulations. 2 refs., 8 figs.

16235 **Filamentary structure of a three-dimensional plasmoid.** Birn, J.; Hesse, M.; Schindler, K. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **94**: No. A1, 241-251(1 Jan 1989).

We have examined the changes of the magnetic field topology and the field line connections of a simple explicit magnetic field model of a plasmoid in different stages from its formation to its complete disconnection from the Earth. Particular emphasis was on the effects of a net cross-tail magnetic field component that breaks the symmetry around the neutral sheet. We find, consistent with the qualititative conclusions of Hughes and Sibeck (1987), that the initial stage of the plasmoid formation is characterized by the formation of helical field lines which cross the neutral sheet typically more than once, but are still connected with the Earth, so that no topology change occurs. In that case a nontopological notion of reconnection is required (Schindler et al., 1988). When reconnection proceeds to lobe field lines, the central plasmoid flux rope becomes enveloped by a sheath of open field lines that pull the plasmoid flux rope back toward the tail. The period of gradual separation of the plasmoid is characterized by a conversion through magnetic reconnection, of helical field lines connected with the Earth to open ones going tailward into interplanetary space. The detailed tracing of magnetic field lines reveals that the structure of the plasmoid region is more complicated than was earlier envisioned. We find that plasmoid field lines no longer form a separate class of field lines as in the symmetric case. During the stage of gradual separation from the Earth the plasmoid is characterized by the central flux rope connected with the Earth which is wrapped by strands of open, partially open, and closed field lines in a filamentary way forming a layer of intermingled flux tubes of different types inside the earlier mentioned sheath of open field lines.

16236 **Three-dimensional equilibria for the extended magnetotail and the generation of field-aligned current sheets.** Birn, J. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **94**: No. A1, 252-260(1 Jan 1989).

Using the magnetotail equilibrium theory and a solution method outlined by Birn (1987), we have constructed self-consistent three-dimensional models for the quiet average magnetotail beyond about 20 R/sub E/ distance but earthward of a potential distant neutral line, which take into account the decrease of the tail flaring with distance. We find that this effect is coupled with the presence of magnetic shear and thus with field-aligned electric currents. These currents have the signature of region 1 currents, toward the Earth on the dawnside and away on the duskside, and contribute about 5 x 10^5 A to the total Birkeland current. They are strongly concentrated near the plasma sheet-lobe boundary and increase toward the flanks of the tail. Associated with the field-aligned currents and the corresponding magnetic field shear there is a bulging effect that tends to deform a circular cross section of the tail near the Earth into one that has bulges in the low-latitude boundary region. We argue that this effect may be the cause for increased interaction with the solar wind in these regions, producing interconnected fields and tailward flowing plasma on magnetospheric-like fields in the low-latitude boundary layer, and deforming this boundary region into the observed dog bone shape of the plasma sheet cross section. copyright American Geophysical Union 1989

16237 **Horse-collar aurora: A frequent pattern of the aurora in quiet times.** Hones E.W. Jr.; Craven, J.D.; Frank, L.A.; Evans, D.S.; Newell, P.T. (Los Alamos National Laboratory, Los Alamos, NM). *Geophysical Research Letters;* **16**: No. 1, 37-40(Jan 1989).

Reported here are DE 1 auroral imager observations of an auroral configuration which is given the name "horse-collar aurora." The horse-collar pattern comprises the total area of auroral emissions from a single hemisphere and derives its name from the shape of the emitting area. The pattern is found in images recorded during quiet geomagnetic conditions and is possibly related to the theta aurora, another quiet time configuration of the auroras. This initial report of the DE 1 observations illustrates the horse-collar aurora with a 2-hour images sequence that displays its basic features and shows an example of its evolution into a theta-like auroral pattern. The interplanetary magnetic field was northward during this image sequence and there is some evidence for IMF B/ sub y/ influence of the temporal development of the horse-collar pattern. A preliminary statistical analysis found the horse-collar pattern appearing in one-third or more of image sequences recorded during quiet conditions; it did not appear during disturbed conditions. Further study is required to establish more fully the characteristics of the horse-collar aurora and to determine its implications concerning solar wind-magnetosphere coupling when the IMF B/ sub z/ is northward. copyright American Geophysical Union 1989

16238 **Signals and noise in measurements of low-frequency geomagnetic fields.** Nichols, E.A.; Morrison, H.F.; Clarke, J. (Engineering Geoscience, Department of Materials Science and Mineral Engineering, and Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley). *Journal of Geophysical Research;* **93**: No. B11, 13743-13754(10 Nov 1988).

The apparent magnetic noise, obtained from the coherency function for two parallel magnetic sensors, generally overstimates sensor noise because the sensors do not measure the same signal. The different signals result from the nonparallel alignment of the sensors and from the additional magnetic signal induced in each sensor by its motion in the Earth's magnetic field. A magnetometer array experiment was completed in Grass Valley, Nevada, to determine the minimum magnetic signal that could be detected in the presence of background natural field variations and motion of the sensor. Superconducting quantum interference device (SQUID) magnetometers with interval biaxial tiltmeters were used to record the magnetic fields and the motion of the sensors.

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REFER ALSO TO CITATION(S) 15228, 15230, 15231, 15232, 15233, 15234, 15323, 15325, 15332, 15338, 15543, 15798, 16306, 16436, 16556, 16557, 16558, 16559, 16560, 16561, 16569, 16570, 16571, 16572, 16573, 16630, 16675, 16690, 16692, 16745, 16776, 16777, 16778, 16780, 16781, 16782, 16783, 16784, 16785, 16786, 16787, 16788, 16789, 16810, 16873

16239 **(BNL—41316) The assessment of geometrical effects on Compton profile measurements.** Gigante, G.E.; Hanson, A.L. (Brookhaven National Lab., Upton, NY (USA)). Oct 1988. Contract AC02-76CH00016. 8p. (CONF-881020—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006183/JAW.

From 4. international symposium on radiation physics; Sao Paulo, Brazil (3 Oct 1988).

Energy dispersive measurements of Compton scattered x rays for analyses have become important with the development of high efficiency, high energy resolution detectors for 50--200 keV x rays. The Compton scattered x ray peak is an inherently broad peak resulting in part from the momentum distribution of the target electrons, referred to as the Compton profile. Hence, information from the width of the Compton peak can be used to study the momentum distribution. The actual peak width also depends on geometrical and attenuation effects. We have begun to assess the geometrical effects and present some of the results. 2 refs., 3 figs.

16240 **(CEA-CONF—9576) Vacuum uv radiation arising from multiphoton ionization of rare gases.** Mainfray, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 5p. (CONF-880435—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756650/JAW.

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

We report the observation of very high order odd harmonics of Nd-YAG laser radiation in rare gases. The harmonic spectrum extends up to the 33rd order (32.2 nm) for Ar. The harmonic intensity falls very slowly beyond the fifth harmonic as the order increases.

16241 (CONF-870155—, pp 243-264) **Detection of the electron density fluctuation induced in solids by swift ions.** Yamazaki, Y. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This paper contains comments and experimental results on the detection of electron density fluctuation induced in solids by swift ions. Also covered are comments on the origin of convoy electrons. 13 figs. (JF)

16242 (CONF-870155—, pp 455-463) **Stopping power of an interacting electron gas for protons.** Nagy, I. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Stopping power caused by the target electrons is calculated considering the response of an electron gas. The free atom electron density is modified according to the Gertner model. The effective stopping power is calculated performing averaging over the impact parameter. 9 refs., 4 figs.

16243 (CONF-870155—, pp 529-538) **K-shell x-ray production by H and He ions at low projectile velocities in solid versus gas targets.** Lapicki, G. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Throughout all these workshops and again at this conference, the effective charge has been utilized to analyze stopping power data. How does Z_1/sup */$/Z_1$ apply in explanation of quantities relevant to our understanding of penetration of charged particles through matter, but other than stopping powers? The quantity that I would like to consider is the inner-shell ionization cross section. I will restrict myself to K-shell x-ray production cross sections by H and He ions because these comprise the data base that I have. This data base was gathered from the literature for another project and it consists of circa 6600 cross sections. 5 figs.

16244 (CONF-870155—, pp 555) **Electronic sputtering of biomolecules.** Sundqvist, B.U.R. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This abstract discusses the electronic sputtering of biomolecules.

16245 **(CONF-8803183—1) Electron degradation and yields of initial products: IV, Subexcitation electrons in molecular oxygen.** Ishii, M.A.; Kimura, M.; Inokuti, M.; Kowari, Ken-ichi. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004282/JAW.

From 34. annual meeting of the Radiation Research Society; Seattle, WA, USA (18 Mar 1988).

Electron-slowing down processes in molecular oxygen gas in the subexcitation domain (below ionization threshold) are studied by using the Spencer-Fano (SF) equation and its simplification, the continuous-slowing-down approximation (CSDA), both in time-dependent and time-independent representations. Compared to N_2 and CO_2 previously studied, O_2 has special features in its inelastic cross sections, namely, strong delta-function-like peaks in the vibrational excitation cross section below 1.3 eV, and very low energy thresholds of electronic excitation channels. These features provide as a stringent test of the CSDA. Indeed, our results clearly show for the first time that the CSDA fails even qualitatively to reproduce the electron degradation spectrum given by the exact SF method over the whole energy regime studied. 7 refs., 10 figs., 1 tab.

16246 **(DOE/ER/13447—4) Investigations and calculations toward increasing the efficiency of muon catalyzed fusion: Progress report, May 1, 1989--April 31, 1989.** Monkhorst, H.J. (Florida Univ., Gainesville (USA). Dept. of Physics). Jan 1989. Contract FG05-85ER13447. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006901/JAW.

This paper briefly describes the muonic molecular ions and the sticking fractions for dtμ. (LSP)

16247 **(DOE/ER/13450—2) Theoretical studies of heavy ion scattering processes: Final report.** Heil, T.G. (Georgia Univ., Athens (USA). Dept. of Physics and Astronomy). Aug 1988. Contract FG09-85ER13450. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006643/JAW.

This report briefly discusses the following topics: charge transfer in N^{+2} + H collisions; Al^{+3} + H transfer reactions; differential cross sections for the charge transfer reaction O^{+2} + He → O^{+} + He^{+}; proton induced fine structure transitions in C II; translation imbedded perturbed stationary states; calculation of charge transfer cross sections for fully-stripped carbon colliding with atomic hydrogen; and adiabatic propagation of three charged particles. (LSP)

16248 **(DOE/ER/13500—1) Unimolecular reaction dynamics and vibrational overtone spectroscopy of highly vibrationally excited molecules: Technical progress report.** Grim, F.F. (Wisconsin Univ., Madison (USA)). 1988. Contract FG02-86ER13500. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006757/JAW.

Highly selective techniques for producing energized molecules along with time-resolved spectroscopic detection schemes provide a means of exploring the spectroscopy, unimolecular reaction, and electronic photodissociation dynamics of highly vibrationally excited molecules. The primary goal is to determine the nature

and chemical behavior of highly vibrationally excited molecules since they are important in combustion, atmospheric chemistry, and complex chemical processes. We obtain spectra of highly vibrationally excited molecules and develop models to describe the energized molecule. Measurements in low pressure gases and in supersonic expansions provide estimates of the reaction rate of a molecule in a single angular momentum state and determine the distribution of the products among their quantum states. These data allow us to make detailed comparison with theoretical predictions. Studies of the electronic photodissociation dynamics reveal unique decomposition processes that arise from molecules reaching portions of the electronically excited potential energy surface that are inaccessible to conventional techniques. 38 refs., 7 figs., 1 tab.

16249 **(DOE/ER/13596—13) Atomic physics of strongly correlated systems: Progress report, 1 February 1988--15 January 1989.** Lin Chii-Dong. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Jan 1989. Contract FG02-86ER13516. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006818/JAW.

This report presents the progress made in our continuing study of strongly correlated atomic systems for the last contract period. In the area of hyperspherical coordinates for Coulombic three-body systems of arbitrary masses a general computing code has been developed. Calculation of the adiabatic potential curves have been accomplished for the e/sup {minus}/e^+e/sup {minus}/ system of arbitrary L, S and parity π. It was found that these curves behave very similar to the potential curves of H/sup {minus}/ except for a mass scaling. We have also examined the mass dependence of the ground state potential curves for systems of three charged particles, AAB, and showed that the curves become more attractive as the mass m/sub A/ becomes larger than m/sub B/. For ion-atom collisions we have examined the transfer-excitation (TE) processes to establish the importance of electron correlations in these two-electron transitions. We have also examined the orientation parameters <L/sub y/> for excited states formed in collisions with positive and negative charged particles to establish the relation between the sign of the charge of the incident particles to the sign of <L/sub y/>.

16250 **(DOE/ER/13720—2) Spectroscopic diagnostics of electron-atom collisions: Progress report, 1 January 1988--31 December 1988.** Gallagher, A. (Colorado Univ., Boulder (USA)). 5 Jan 1989. Contract FG02-87ER13720. 3p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006079/JAW.

The fully-differential sodium electron excitation experiment has been completed during this contract year. This is a major milestone in our research program, as well as for electron-atom collision physics.

16251 **(DOE/ER/45234—3) The structure and reactivity of heterogeneous surfaces and study of the geometry of surface complexes: Progress report, January 1, 1988--December 31, 1988.** Landman, U. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1988. Contract FG05-86ER45234. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005726/JAW.

This research covers a wide range and scope of material systems and phenomena encompassing a number of systems in various degrees of aggregation (finite clusters and extended systems), thermodynamic states (liquids and solids under equilibrium and non-equilibrium conditions), and characteristic interactions (metals, ionic and polar materials and covalent interactions). Progress during this report is discussed under the following categories: (1) Materials preparation and growth: Liquid-phase and Molecular Beam Epitaxial growth of semiconductors (silicon); amorphous semiconductors. (2) Material surfaces and interfaces: Phase-transformations (surface premelting); surface probes (tip-substrate interactions in Atomic Force Microscopy, AFM); stressed interfaces and interphase (solid-liquid at equilibrium and under shear stress). (3) Finite aggregates: The structure and dynamics of ground state and excited state atomic and molecular clusters and fragmentation dynamics; size dependence of physical phenomena in finite material systems; excess electron attachment, solvation, migration and spectroscopy in polar molecular clusters (water and ammonia); quantum droplets ((^{4}He)/sub n/, $50 < n < 300$) at finite temperature.

16252 **(GSI—88-59(prepr.)) Comments on 'electron peaks in e/sup +/ + Th, U and Ta interactions'.** Tsertos, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1988. 7p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

The observation of a peak structure in the electron spectra resulting from e/sup +/ + Th, U collisions with a measured FWHM of (3.7+-0.5) keV cannot be attributed to a new phenomenon, i.e. the e/sup +/e/sup -/ decay of neutral particle as recently claimed, because in this case the expected resonance width is broadened to at least 60 keV (FWHM) in the laboratory frame, due to the motion of the bound electrons.

16253 **(GSI—88-66(prepr.)) On the momentum correlation of (e/sup +/e/sup -/)-pairs observed in U+U and U+Pb collisions.** Koenig, W.; Berdermann, E.; Bosch, F.; Kienle, P.; Kozhuharov, C.; Schuhbeck, S.; Tsertos, H.; Huchler, S.; Schroeter, A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Nov 1988. 14p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

First results on the energy and angular dependence of the (e/sup +/e/sup -/)-pairs, emitted from U+U and U+Pb collisions at a beam energy of 5.9 MeV/u, are presented. The (e/sup +/e/sup -/)-coincidence measurements were carried out utilizing a double-Orange β-spectrometer, which allows to determine the momentum vectors of the positrons and electrons and, hence, their opening angle θsub(e/sup +/e/sup -/). The (e/sup +/e/sup -/)-sum- energy spectrum obtained for θsub(e/sup +/e/sup -/) = (180+-20)/sup 0/, which is equivalent to an invariant mass spectrum, indicates multiple-line structures in the energy range between 500 keV and 950 keV for both collision systems. The most pronounced line appears at a sum energy of $\simeq$ 810 keV, corresponding to an invariant mass of $\simeq$ 1.83 MeV/c/sup 2/. No evidence for line structures was found for angles 40/sup 0/ $\leqq$ θsub(e/sup +/e/sup -/) $\leqq$ 170/sup 0/. The energies of the lines are consistent with our previous observations in the single positron spectra.

16254 **(GSI—88-68-Prepr.) Narrow positron line emission in collisions of very heavy ions. - Experiments on low energy Bhabha scattering search for neutral resonances in the MeV/c/sup 2/ mass region.** Bokemeyer, H.; Kozhuharov, C. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Dec 1988. 11p. (CONF-880867—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756804/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

This report contains two short reviews concerning the observation of narrow positron lines in heavy-ion collisions and the search for the e/sup +/e/sup -/ decay of a postulated neutral boson by means of low-energy Bhabha scattering. See hints under the relevant topics. (HSI).

16255 (IA—1440, pp 6) **Interionic correlations in plasmas. Thomas-Fermi hypernetted-chain density-functional theory.** Ofer, A.; Nardi, E.; Rosenfeld, Y. (Ben-Gurion Univ. of the Negev, Beersheba (Israel); Weizmann Inst. of Science, Rehovoth (Israel); Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16256 (IA—1440, pp 7-8) **Electron collision excitations in complex spectra of ionized heavy atoms.** Bar-Shalom, A.; Oreg, J.; Klapisch, M. (Israel Atomic Energy Commission, Tel Aviv; Hebrew Univ., Jerusalem (Israel)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16257 (IA—1440, pp 72) **Gain predictions for nickel-like gadolinium from a very complete collisional-radiative model.** Goldstein, W.H.; Oreg, J.; Zigler, A.; Bar-Shalom, A.; Klapisch, M. (Lawrence Livermore National Lab., CA (USA); Israel Atomic Energy Commission, Tel Aviv; Hebrew Univ., Jerusalem (Israel)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16258 **(IAE—4606/2) Mechanisms of mesic molecules dtμ and ddμ formation in gas.** Men'shikov, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 52p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705445/JAW.

The mechanisms of mesic molecules ddμ and dtμ formation in D/sub 2/+T/sub 2/ mixture of high density are studied and the rates of these processes are obtained. The known at present formation rate dependencies nonlinear in gas density follows from the formulas of this paper as their limiting cases. 27 refs.; 4 figs.

16259 (INIS-mf—11348, pp 68) **Comprehensive model for positronium formation and related phenomena of its inhibition and enhancement.** Lazzarini, Ennio. (Politecnico di Milano (Italy). Centro Studi Nucleari E. Fermi). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16260 (INIS-SU—68, pp 551) **Description of charged particle elastic scattering cross section based on space charge by paraxial beam method.** Kaurov, V.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16261 (INIS-SU—69, pp 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A.; Safronova, U.I. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.

In Experimental and theoretical physics. Collection.

The transitions from 2s/sup -1/ and 2p/sup -1/3l states into the 1s/sup 2-/2s/sup 2/2p/sup 6/ in Ne-like ions are considered. The measured and calculated energy values are given for Ag/sup 37+/ and Xe/sup 44+/. The correlation correction to the energies of 3l levels of Ne-like ions is estimated. It is shown that this correction determines the greater part of calculation error by the method of multiconfiguration system of Dirac-Fock equations. 8 refs.; 2 tabs.

16262 **(IPNO-DRE—87-35) Radioactive heavy ion secondary beams.** Bimbot, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 22p. (CONF-8710373—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756682/JAW.

From Symposium on heavy-ion collisions; Shimoda, Japan (11 Oct 1987).

The production of secondary radioactive beams at GANIL using the LISE spectrometer is reviewed. The experimental devices, and secondary beam characteristics are summarized. Production of neutron rich secondary beams was studied for the systems Ar40 + Be at 44 MeV/u, and 018 + Be at 45 and 65 MeV/u. Partial results were also obtained for the system Ne22 + Ta at 45 MeV/u. Experiments using secondary beams are classified into two categories: those which correspond to fast transfer of nuclei from the production target to a well shielded observation point; and those in which the radioactive beam interacts with a secondary target.

16263 **(LA—11369-MS) ILS [intracavity laser spectroscopy] for beam sensing (experiment): Final report.** Hoida, H.W.; Jahoda, F.C. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 48p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006376/JAW.

Intracavity laser spectroscopy (ILS) was studied with lithium as the absorber within a dye laser. Also studied was lithium within a chromium-perovskite solid-state laser. The dye laser was turned on quickly for one mode of operation as well as scanned in wavelength for the other two modes of operation. The wavelength scanning was accomplished with a birefringent electro-optic tuner, which was varied in scanning frequency and wavelength amplitude. For broadband ILS with the laser turned on quickly, the absorption was observed to grow exponentially until it saturated. Two different modes of operation were observed when the laser was scanned. At low frequencies (less than 30kHz) the results were similar to the broadband ILS in that the depth of the growth was dependent on the spectral dwell time (the time the laser lases at one wavelength). For fast scanning at the cavity resonance period, the absorption feature broadened in wavelength as the resonance frequency was approached although the total absorption remained about the same. The chromium-perovskite solid-state laser was also used with broadband ILS. The absorption feature was observed. 21 refs., 1 fig., 1 tab.

16264 **(LA—11436-M-Vol.3) Theoretical atomic physics code development III TAPS: A display code for atomic physics data.** Clark, R.E.H.; Abdallah, J. Jr.; Kramer, S.P. (Los Alamos National Lab., NM (USA)). Dec 1988. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005977/JAW.

A large amount of theoretical atomic physics data is becoming available through use of the computer codes CATS and ACE developed at Los Alamos National Laboratory. A new code, TAPS, has been written to access this data, perform averages over terms and configurations, and display information in graphical or text form. 7 refs., 13 figs., 1 tab.

16265 **(LBL—26331) Infrared spectroscopy of weakly bound molecular ions.** Yeh, Lisa I-Ching. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 179p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006602/JAW.

The infrared spectra of a series of hydrated hydronium cluster ions and of protonated ethane ion are presented. A tandem mass spectrometer is ideally suited to obtaining the spectra of such weakly bound molecular ions. Traditional absorption spectroscopy is not feasible in these situations, so the techniques described in this thesis make use of some consequence of photon absorption with higher sensitivity than simply attenuation of laser power. That consequence is dissociation. By first mass selecting the parent ion under study and then mass selecting the fragment ion formed from dissociation, the near unit detection efficiency of ion counting methods has been used to full advantage.

16266 **(LBL—26332) Photodissociation of cyclic compounds in a molecular beam.** Zhao, Xinsheng. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 226p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006718/JAW.

A discussion on the dynamics and kinematics of photofragmentation-translational spectroscopy is presented, and the results are applied to experimental studies of four cyclic compounds: hexahydro-1,3,5- trinitro-1,3,5-triazine (RDX), s-tetrazine (ST), cyclohexene, (CHN), and 1,4-cyclohexadiene (CHDN). In infrared multiphoton dissociation (IRMPD) of RDX, the dominant primary channel is concerted triple fission to produce three $CH_2N_2O_2$ fragments which subsequently undergo secondary dissociation. Concerted reactions predominate over simple bond rupture not only in the number of channels, but also in the amount of products. Following ^{1}B/sub 3u/ ← ^{1}A/sub g/ ($S_1 \leftarrow S_0$) or ^{1}B/sub 2u/ ← ^{1}A/sub g/ (248 nm) excitation, ST reverts to the highly vibrationally excited ground electronic state through internal conversion (IC), and then decomposes into 2HCN + N_2 via concerted triple dissociation. The

asymptotic angles between the N_2 and HCN groups from the center-of-mass of ST are 117.2{degree} and 114.4{degree} for $S_1 \leftarrow S_0$ and 248 nm excitation respectively.

16267 (LBL-PUB—433-6-88/255, pp 1880-1892) **Diffusion and localization of positive muons and pions in copper.** Seeger, A. 5 Jun 1988. NTIS, PC A04/MF A01. Order Number DE88012074/JAW. Contract AC03-76SF00098.

In μSR newsletter No. 34.

The possibility to implant spin-polarized positive muons (μ^+) into solids and to study their behavior by means of the so-called μSR technique allows us to investigate the importance of quantum effects for the diffusion and location of light particles in considerable detail. The questions that can be answered depend on the interactions of the magnetic moments of the muons with internal magnetic fields. The present paper reviews work on copper, where the dominant magnetic interaction is that with the nuclear moments. It is shown that recent results obtained by means of the time-differential π^+/μ^+ lattice-steering technique supplement the μSR work very well. From the experiments it is concluded that in copper tetrahedral interstices provide metastable sites for μ^+ and π^+ (= positive π mesons) in addition to the stable sites in octahedral interstices. Down to about 10 K the metastable sites are not occupied directly during the thermalization process of the implanted probes. The rather complex situation of the μSR measurements below about 10 K is discussed in some detail. It is argued that a quantitatively satisfactory theory is not available at present but that the occupation of the metastable sites and the transition of μ^+ from these sites into the stable octahedral sites is likely to play a r{cflx o}le. 53 refs., 2 figs., 3 tabs.

16268 (LBL-PUB—433-6-88/255, pp 1893-1909) **Muonium atoms compared to hydrogen atoms and hydrated electrons through reactions with nitrous oxide and 2-propanol.** Venkateswaran, K.; Barnabas, M.; Wu, Zhennan; Walker, D.C. 5 Jun 1988. NTIS, PC A04/MF A01. Order Number DE88012074/JAW. Contract AC05-84OR21446.

In μSR newsletter No. 34.

N_2O and 2-propanol constitute a pair of solutes with completely opposite relative reactivities towards H and e/sub aq//sup {minus}/. It is observed in the present study that muonium atoms (Mu) fall directly between H and e/sub ag//sup {minus}/ for both of these reactions. Aspects of mass-dependent processes and kinetics isotope effects are discussed with regard to these findings. 15 refs., 2 figs., 3 tabs.

16269 (LBL-PUB—433-6-88/255, pp 1910-1920) **Micelle-induced enhancements of the reactivity of muonium atoms in dilute aqueous solutions.** Venkateswaran, K.; Barnabas, M.V.; Wu, Zhennan; Stadlbauer, J.M.; Ng, B.W.; Walker, D.C. 5 Jun 1988. NTIS, PC A04/MF A01. Order Number DE88012074/JAW. Contract AC03-76SF00098.

In μSR newsletter No. 34.

Enhancements in rate constants from 10^6 M/sup {minus}1/s/sup {minus}1/ to more than 10^{10} M/sup {minus}1/s/sup {minus}1/ have been found for the reaction of muonium atoms with 2-propanol in water when micelles are added. 13 refs., 4 figs., 1 tab.

16270 (LBL-PUB—433-6-88/255, pp 1921-1923) **Spin depolarisation by diffusion on lattices.** Czech, R. 5 Jun 1988. NTIS, PC A04/MF A01. Order Number DE88012074/JAW. Contract AC03-76SF00098.

In μSR newsletter No. 34.

The decay of the polarization P(t) of an initially polarized ensemble of spins due to random walk processes is investigated. In contrast to previous work, where the stochastic process acting on the individual rotating spins is assumed to be Gaussian, in this work the stochastic processes resulting from actual random walks on d-dimensional lattices are considered. Random local rotation frequencies are assigned to the vertices of the lattices; the frequencies are typically chosen from a Gaussian probability distribution with zero mean and width σ. For simplicity mainly the case of transverse spin rotation is studied.

16271 (LBL-PUB—433-6-88/255, pp 1924-1940) **Spin depolarization of a quantum particle on a linear chain with alternating Larmor frequencies.** Kehr, K.W.; Kitahara, Kazuo. 5 Jun 1988. NTIS, PC A04/MF A01. Order Number DE88012074/JAW. Contract AC03-76SF00098.

In μSR newsletter No. 34.

The spin depolarization of a particle on a linear chain with alternating Larmor frequencies is considered. The particle is initially prepared at one site with polarized spin. A crossover is found from initially classical behavior to an asymptotic polarization, as a consequence of quantum-mechanical tunneling. The influence of dynamical fluctuations on the spin depolarization is studied in the frame of the Haken-Strobl model. 7 refs., 4 figs.

16272 (PPPL—2578) **Low frequency electrostatic instabilities excited by injection of an electron beam in space.** Hwang, Y.S.; Okuda, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006882/JAW.

One-dimensional particle simulations have been carried out to study the low frequency broadband electrostatic noise that propagates almost perpendicularly from the magnetic field line when a nonrelativistic electron beam is injected into space from a spacecraft. For T/sub e/ = T/sub i/ the electrostatic ion cyclotron waves appear as well as the waves near the lower hybrid frequency. When the magnetic field is reduced so that Ω/sub e/ << ω/sub pe/ in a non-isothermal plasma, T/sub e/ > T/sub i/, oblique ion acoustic instabilities appear to propagate almost perpendicular to the magnetic field. In addition, a very low frequency mode at ω << Ω/sub i/ is found to be generated by the electrons flowing into the conductor. Both the ion injected beam electrons as well as the ambient electrons flowing into the spacecraft are responsible for generating those instabilities, which accelerate ions perpendicular to the magnetic field. 11 refs., 9 figs.

16273 (UCID—21544) **Electron-ion coupling in LASNEX.** Eder, D.C. (Lawrence Livermore National Lab., CA (USA)). 4 Oct 1988. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007278/JAW.

The current model of electron-ion coupling in LASNEX is reviewed. The model includes the effect of degeneracy and the effects of high density enter in the use of a minimum value for the Coulomb logarithm. We conclude that this model is adequate for the problems presently modeled with LASNEX. 5 refs.

16274 (UCRL—21146) **Relativistic distorted wave collision strengths for excitation to the 88 n = 3 and n = 4 levels in all 71 neon-like ions with 22 ≦ Z ≦ 92.** Zhang, Hong Lin; Sampson, D. H. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 63p. NTIS, PC A04 - OSTI. Order Number DE89006772/JAW.

Relativistic distorted wave collision strengths are given for the 88 possible transitions between the ground level and the excited levels with n = 3 and n = 4 in the 71 neon-like ions with nuclear charge number Z in the range 22 ≦ Z ≦ 92. The calculations are made for the six final, or scattered, electron energies E' = 0.008, 0.04, 0.10, 0.21, 0.41 and 0.75, where E' is in units of Z/sub eff/^{2} Rydbergs with Z/sub eff/ = Z {minus} 7.5. In addition, the transition energies and electric dipole oscillator strengths are given. 10 refs., 4 tabs.

16275 (UCRL—99037) **Recombination and dissociative recombination of H_2i and H_3^+ ions on surfaces with application to hydrogen negative ion sources.** Hiskes, J.R.; Karo, A.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 5p. (CONF-890145—8). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006211/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

A four-step model for recombination and dissociative recombination of H_2^+ and H_3^+ ions on metal surfaces is discussed. Vibra-

tionally excited molecules, $H_2(v'')$, from H_3^+ recombination are produced in a broad spectrum that enhances the excited level distribution. The application of this latter process to hydrogen negative ion discharges is discussed. 5 refs., 3 figs., 1 tab.

16276 **(X-EP-LOQ-RA—1985) Annual report of the Quantum Optics Laboratory, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 540p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756709/JAW.

Research on excited rotational vibration levels of molecules containing several equivalent bonds; nonlinear optics in a steady regime: focusing and stabilization of a synchronously pumped femtosecond laser; vibration dynamics in the condensed phase; nonlinear optics in composite media; and nonlinear interaction of waves in cavities is presented.

16277 **(X-EP-LOQ-RA—1987) Annual report of the Quantum Optics Laboratory, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 22p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756710/JAW.

Research on excited rotational vibration levels of molecules containing several equivalent bonds; vibrational dynamics in the dense phase; nonlinear spectroscopy with temporal resolution; nonlinear optics properties of composite materials and metal aggregates and semiconductors; intracavity nonlinear interactions of light waves; and molecule surface interaction is presented.

16278 (ZfK—584, pp 64) **50 kV fine focused ion beam apparatus.** Hoffmann, A.; Kahn, A.; Kreissig, K.; Naehring, F.K. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16279 **Multiphoton ionization of vibrationally hot nitric oxide produced in a pulsed supersonic glow discharge.** Feigerle, C.S.; Miller, J.C. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6125). *Journal of Chemical Physics;* **90**: No. 6, 2900-2908(15 Mar 1989).

Mass-resolved, resonant multiphoton ionization (MPI) spectroscopy has been used to identify and characterize transient species produced in a pulsed, supersonic glow discharge source. Vibrationally hot (up to $v'' = 9$), but rotationally cold nitric oxide is characterized by (1+1) MPI via the A $^2\Sigma^+$ state and (2+1) MPI through the C ^{2}Pi/sub r/ state. Nine Aleft-arrowX and six Cleft-arrowX hot bands are observed; only four of these have been previously characterized. Accidentally overlapping C and A state hot bands can be separately studied by using different order MPI schemes. Implications for several previous studies are discussed. Additionally, the ^{3}P/sub 0,2/ metastable rare gas atoms are readily formed and detected by MPI as are metal atoms sputtered from the electrodes.

16280 **Structure and dissociation dynamics of the Ne_2Cl_2 van der Waals complex.** Hair, S.R.; Cline, J.I.; Bieler, C.R.; Janda, K.C. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Journal of Chemical Physics;* **90**: No. 6, 2935-2943(15 Mar 1989).

The structure and dynamics of Ne_2Cl_2 and Ne_3Cl_2 are studied by laser pump—probe spectroscopy. Analysis of a rotationally resolved Bleft-arrowX excitation band shows that Ne_2Cl_2 has a distorted tetrahedral structure with a Ne—Ne bond length of 3.23 A and Ne_2 center of mass to Cl_2 center of mass distance of 3.12 A. This structure is very close to that predicted by summing the atom—atom interactions. Excitation spectral shifts suggest a Ne_3Cl_2 structure with the neon atoms encircling the Cl_2 bond axis. The total van der Waals binding energy of Ne_2Cl_2 is found to be between 145.6 and 148.6 cm^{-1}, which is 20 cm^{-1} greater than $2*D_0(Ne—Cl_2)+D_0(Ne_2)$. For Cl_2 stretching levels below $v' = 10$, transfer of one Cl_2 vibrational quantum to the van der Waals vibrational modes is sufficient to dissociate both neon atoms from the complex. This indicates that the two neon atoms need not dissociate via independent, impulsive "half-collisions" which would require two Cl_2 vibrational quanta. Observation of a $NeCl_2$ dissociation fragment, however, indicates that such a sequential mechanism competes with the direct dissociation. Cl_2 fragment rotational state population distributions for different initial vibrational levels are characterized using a simple rotational surprisal analysis. Comparison of these surprisal plots to those of the $NeCl_2$ dissociation shows that as the size of the complex increases, so does the degree of statistical redistribution during the reaction.

16281 **Electron degradation and yields of initial products. IV. Subexcitation electrons in molecular oxygen.** Ishii, M.A.; Kimura, M.; Inokuti, M.; Kowari, K. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **90**: No. 6, 3081-3086(15 Mar 1989).

Electron slowing-down processes in molecular oxygen gas in the subexcitation domain (below the ionization threshold) are studied by using the Spencer—Fano (SF) equation and its simplification, the continuous-slowing-down approximation (CSDA), both in time-dependent and time-independent representations. Compared to the previously studied cases of N_2 and CO_2, O_2 has the special features in its inelastic cross sections of (i) strong delta-function-like peaks in the vibrational excitation cross section below 1.3 eV and (ii) very low energy thresholds of electronic excitation channels. These features provide a stringent test for the CSDA. Indeed, our results clearly show for the first time that the CSDA fails even qualitatively to reproduce the electron degradation spectrum given by the exact SF method over the whole energy regime studied.

16282 **Rotational branching ratios at low photoelectron energies in resonant enhanced multiphoton ionization of NO.** Rudolph, H.; McKoy, V.; Dixit, S.N. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **90**: No. 5, 2570-2574(1 Mar 1989).

We report calculated rotational branching ratios for very low energy (50 meV) photoelectrons resulting from (1+1') resonant enhanced multiphoton ionization (REMPI) via the J/sub i/ = 1/2, 3/2, 5/2, and 7/2 levels of the P/sub 11/ branch of the A $^2\Sigma^+$ ($3s\sigma$) state of NO. Even angular momentum transfer (ΔNequivalentN/sub +/-N/sub i/) peaks are dominant in these rotational distributions, in agreement with the selection rule $\Delta N+1$ = odd. Angular momentum coupling in the photoelectron wave function arising from the molecular ion potential leads to smaller but appreciable ΔN = odd peaks. The calculated $\Delta N = 0$ to $\Delta N = +2$ peak ratios show the same strong decrease when J/sub i/ increases from 1/2 to 3/2 as seen in the experimental zero-kinetic-energy (ZEKE) photoelectron spectra [Sander et al., Phys. Rev. A 36, 4543 (1987)], but do not show the rapid die-off of the ΔNnot =0 peaks for higher J/sub i/ observed experimentally. The calculated trend in the $\Delta N = +2$ vs $\Delta N = 0$ peaks could be understood on the basis of simple angular momentum transfer arguments. These same arguments indicate that this trend in the $\Delta N = 0$ and +2 peaks with increasing angular momentum is not generally expected in other branches. Spectra via the R/sub 21/ (J) branch are presented to support this assertion. We also present photoelectron angular distributions which show a strong dependence on ΔN reflecting the changing composition of the photoelectron wave function.

16283 **Reconciling the "strange" and "ordinary" polarizations of the classical atom.** Solem, J.C. (University of Illinois at Chicago, Department of Physics, Box 4348, Chicago, Illinois 60680). *American Journal of Physics;* **57**: No. 3, 278-279(Mar 1989).

The counterintuitive transverse electric-field response of a hydrogenic atom is reconciled with the customary notion of dielectric polarization.

16284 **Intermediate-coupling calculations for the dielectronic recombination of P-like ions.** Badnell, N.R.; Pindzola, M.S. (Department of Physics, Auburn University, Auburn, Alabama 36849-5311). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 4, 1685-1689(15 Feb 1989).

We have calculated $\Delta n = 0$ dielectronic recombination cross sections and rate coefficients for the B-like ions C^+, N/sup 2+/, O/sup 3+/, and F/sup 4+/ in the LS-coupling and intermediate-

coupling approximations, using the program Au-smcapst-smcapso-smcapsSt-smcapsr-smcapsu-smcapsc-smcapst-smcapsu-smcapsr-smcapsE, as well as in a partitioned configuration-average approximation (PCA). There is broad agreement between the zero-field PCA results and the LS-coupling and intermediate-coupling results, which differ by no more than 10%. The experimental cross sections obtained by Dittner et al. lie between the zero-field and the maximum-field-enhanced PCA results, the enhancement being a factor of 3. In the case of the rate coefficients the general formula of Burgess was found to overestimate the zero-field results by a factor of between 1.3 and 1.8, mainly due to the neglect of autoionization into excited states.

16285 **Intermediate-coupling effects in the dielectronic recombination of oxygen ions.** Badnell, N.R.; Pindzola, M.S. (Department of Physics, Auburn University, Auburn, Alabama 36849-5311). *Physical Review [Section] A: General Physics;* **39**: No. 4, 1690-1695(15 Feb 1989).

We have calculated $\Delta n = 0$ dielectronic recombination (DR) cross sections and rate coefficients for O/sup q/$^+$, q = 1—5, in configuration-mixing LS-coupling and intermediate-coupling approximations, using the program Au-smcapst-smcapso-smcapsSt-smcapsr-smcapsu-smcapsc-smcapst-smcapsu-smcapsr-smcapsE, as well as in a partitioned configuration-average (PCA) approximation. The intermediate-coupling cross sections (rate coefficients) are about 45% (25%) greater than the LS-coupling results in the case of O^+ and O/sup 5+/, due to the effect of core fine-structure interactions, while the increase is no more than 10% (5%) for O/sup 2+/, O/sup 3+/, and O/sup 4+/. There is good agreement between the zero-field PCA results and the intermediate-coupling results when DR takes place through a single core term, as in O^+, O/sup 4+/, and O/sup 5+/, but the PCA approximation gives poorer results when DR proceeds through more than one core term, as in O/sup 2+/ and O/sup 3+/. The maximum-field-enhanced PCA results are about a factor of 3 greater than the zero-field results. In the case of the rate coefficients the general formula of Burgess was found to overestimate the zero-field results by a factor of between 1.3 and 1.8 due to the neglect of autoionization into excited states or the averaging over incident angular momentum.

16286 **Resonant multielectron transfer in solid oxides following double K-shell ionization by heavy-ion impact.** Bandong, B.B.; Watson, R.L. (Cyclotron Institute and Department of Chemistry, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] A: General Physics;* **39**: No. 4, 1714-1724(15 Feb 1989).

The Kα hypersatellite spectra of oxygen, obtained by bombardment of various solid oxides with 2-MeV/amu beams of C and Ar ions, were measured using a curved-crystal spectrometer. In the spectra for the compounds CaO, SrO, CeO_2, and three of the oxides of Ti, some of the hypersatellite peaks appeared to be enhanced while others were suppressed. These features are indicative of resonant electron transfer processes caused by the energy matching of valence levels in the multiply ionized oxygen ion with those of its neighboring metal ions. In all cases except CaO, the spectra suggest that correlated multielectron transfer is involved, in which as many as four electrons are exchanged between the two ions. A method developed previously for estimating the energy change associated with the electron exchange was generalized to cover multielectron transfer, and corrections for extra-atomic relaxation were included. Calculations employing this method strongly support the resonant multielectron transfer hypothesis.

16287 **Ac Stark effect for short-range potentials with intense electromagnetic fields.** Bardsley, J.N.; Comella, M.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **39**: No. 4, 2252-2255(15 Feb 1989).

The energy spectrum of a charged particle bound by a short-range potential and subjected to an intense ac electromagnetic field is computed by using complex coordinates within the Floquet formalism. As the field strength is raised, additional discrete states appear and the lifetime of the states increase. The adequacy of a high-frequency model of the strong-field spectra is assessed.

16288 **Variational sticking-fraction calculations for the excited states of the tdμ molecular ion.** Haywood, S.E.; Monkhorst, H.J.; Szalewicz, K. (Quantum Theory Project, Department of Physics and Department of Chemistry, University of Florida, Gainesville, Florida 32611). *Physical Review [Section] A: General Physics;* **39**: No. 4, 1634-1638(15 Feb 1989).

We have calculated variational wave functions for the excited states of the tdμ molecule using a Coulombic Hamiltonian. These functions were used to find the probability, known as the sticking fraction, that after fusion the muon would remain bound to the alpha particle. The sticking fractions were found to be (0.888 +- 0.002) x 10/sup -2/ for the J = 0, ν = 1 state and (0.29 +- 0.01) x 10/sup -2/ for the J = 1, ν = 0 state. The sticking fraction of the highest bound state of tdμ, J = 1, ν = 1, did not converge. In addition, we have found the expectation values of the distances between particles for the lower (00), (01), and (10) states.

16289 **Merged-beams measurements of electron-capture cross sections for O/sup 5+/+H at electron-volt energies.** Havener, C.C.; Huq, M.S.; Krause, H.F.; Schulz, P.A.; Phaneuf, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6372). *Physical Review [Section] A: General Physics;* **39**: No. 4, 1725-1740(15 Feb 1989).

Absolute total cross-section measurements are presented for electron capture in O/sup 5+/+H(D) collisions over the energy range 0.9—800 eV/amu. These are the first experimental data to be reported using a new multicharged-ion—atom merged-beams apparatus developed at Oak Ridge National Laboratory. The experimental method and the cross-section measurements are described in detail. At energies below 2 eV/amu, the data show a cross-section enhancement which may be attributed to the ion-induced dipole attraction between the reactants. Agreement with recent unpublished quantum-mechanical calculations ranges from fair at the lower energies to excellent at the higher energies.

16290 **State-selective double-electron capture in He/sup 2+/ + He collisions at intermediate impact energies.** Jain, A.; Lin, C.D.; Fritsch, W. (Physics Department, Kansas State University, Manhattan, Kansas 66506). *Physical Review [Section] A: General Physics;* **39**: No. 4, 1741-1746(15 Feb 1989).

We report calculations of cross sections for electron capture to individual doubly excited states for 150—500-keV ^{3}He/sup 2+/ ions colliding with helium atoms. By adopting an independent-electron approximation, the capture probability to each doubly excited state is calculated in terms of single-capture amplitudes to each substate which are properly weighted with configuration-interaction coefficients. The validity of such an approximation is checked by comparing the results with calculations in which the electron correlation was considered explicitly. The calculated final results for double capture to the $(2s^2)\ ^1S$, $(2s2p)^1P$, and $(2p^2)^1D$ states are in fair agreement with the recent experiment of Zouros et al. [Phys. Rev. A 35, 1963 (1987)].

16291 **Electron-impact ionization of Se/sup 24+/.** Moores, D.L.; Reed, K.J. (High Temperature Physics Division, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **39**: No. 4, 1747-1755(15 Feb 1989).

Cross sections for electron-impact ionization of neonlike selenium have been calculated using close-coupling wave functions. We report cross sections for ionization of the $2s^22p^6\ ^1S$ ground state and the $2s^22p^53s\ ^3P$ excited state of the ion. We found numerous resonances in the ejected electron channels due to excitation of $2s^22p^43snl$ autoionizing states. The resonances are very narrow, but some have peaks that are several orders of magnitude above the nonresonant background cross section. Even with radiative decay taken into account, the resonances enhance the total integrated cross section by nearly a factor of 4.

16292 H^- formation in a barium-seeded hydrogen discharge. Leung, K.N.; Walther, S.R.; Kunkel, W.B. (Accelerator and Fusion Research Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720). *Physical Review Letters;* **62**: No. 7, 764-767(13 Feb 1989).

It has been found that the H^- output current from a multicusp source can be substantially increased if the hydrogen plasma is seeded with cesium or barium. Experimental results demonstrate that, for a pure hydrogen discharge, the H^- ions extracted from a multicusp source are indeed produced in the plasma volume. However, if barium is mixed with hydrogen in the source discharge, the majority of the H^- ions are generated on the anode walls.

16293 Implication of nonintegral occupation number and Fermi-Dirac statistics in the local-spin-density approximation applied to finite systems. Dhar, S. (Department of Chemistry, Louisiana State University, Baton Rouge, Louisiana 70803). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 952-957(1 Feb 1989).

In electronic-structure calculations for finite systems using the local-spin-density (LSD) approximation, it is assumed that the eigenvalues of the Kohn-Sham equation should obey Fermi-Dirac (FD) statistics. In order to comply with this assumption for some of the transition-metal atoms, a nonintegral occupation number is used which also minimizes the total energy. It is shown here that for finite systems it is not necessary that the eigenvalues of the Kohn-Sham equation obey FD statistics. It is also shown that the Kohn-Sham exchange potential used in all LSD models is correct only for integer occupation number. With a noninteger occupation number the LSD exchange potential will be smaller than that given by the Kohn-Sham potential. Ab initio self-consistent spin-polarized calculations have been performed numerically for the total energy of an iron atom. It is found that the ground state belongs to the $3d^64s^2$ configuration. The ionization potentials of all the Fe/sup n/+ ions are reported and are in agreement with experiment.

16294 Binding energies for p electrons in negative alkaline-earth elements. Fischer, C.F. (Vanderbilt University, Box 6035B, Nashville, Tennessee 37235). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 963-970(1 Feb 1989).

Multiconfiguration Hartree-Fock (MCHF) calculations recently predicted a positive binding energy for the p electron in the s^2p^2P state of Ca^-, in good agreement with experiment. The present paper explores the binding of electrons in several alkaline-earth elements. Fixed-core Hartree-Fock potentials demonstrate the angular momentum barrier. From a simple correlation study it is shown that the $3d^24p$ configuration relative to the $3s^23p$ configuration in Mg^- lies much higher than the $(n-1)d^2np$ configurations relative to ns^2np in the heavier alkaline-earth elements. Accurate MCHF correlation studies are reported for two and three electrons outside a core from which binding energies are predicted for Ca^-, Sr^-, and Ba^-. Not included is correlation with the core (core polarization) and correlation within the core. The same procedures were also applied to Sc. Theoretical results with relativistic shift corrections are compared with experiment in the case of Ca^- and Sc.

16295 Multiphoton ionization of rare gases using multichannel-quantum-defect theory. L'Huillier, A.; Tang, X.; Lambropoulos, P. (Department of Physics, University of Southern California, University Park, Los Angeles, California 90089-0484). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 1112-1122(1 Feb 1989).

We apply multichannel-quantum-defect theory (MQDT) to multiphoton ionization of rare gases in lowest-order perturbation theory. We determine MQDT parameters of J = 1,3 odd-parity states, J = 0,2 even-parity states in xenon and krypton by fitting experimental energy levels and constructing Lu-Fano plots. We present calculations of two- and three-photon ionization of xenon and krypton in the autoionization region between the two thresholds. We compare autoionization spectra and also photoelectron angular distributions to experimental data [S. T. Pratt, P. M. Dehmer, and J. L. Dehmer, Phys. Rev. A 35, 3793 (1986); J. L. Dehmer, S. T. Pratt, and P. M. Dehmer, ibid. $fat 36: , 4494 (1987)]. Agreement between theory and experiment is reasonable, especially for krypton.

16296 Keldysh approximation, A^2, and strong-field ionization. Milonni, P.W.; Ackerhalt, J.R. (Theoretical Division (T-12), Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 1139-1148(1 Feb 1989).

The Keldysh approximation as applied to above-threshold ionization (ATI) is compared with conventional (weak-field) perturbation theory and the Kroll-Watson theory of electron scattering in intense fields. Unlike the latter "nonperturbative" theory, the Keldysh approximation treats the effects of the field on the initial and final states differently, and this leads to a spurious contribution from the A^2 part of the Hamiltonian in the Axp gauge. We attempt to clarify the role of the ponderomotive potential in ATI and the influence of the A^2 term on the polarization dependence of the transition amplitude. The fundamental defect of the Keldysh approximation with regard to A^2 is shown to be of little practical consequence for the experiments carried out thus far. However, it is shown that the Keldysh amplitude is not "exact" in the applied field, as sometimes claimed, and is best regarded as an ansatz rather than a leading term in a gauge-invariant perturbation expansion. A simple modification of the Keldysh theory is proposed.

16297 Angular distribution of ejected electrons in resonant Auger processes of Ar, Kr, and Xe. Carlson, T.A.; Mullins, D.R.; Beall, C.E.; Yates, B.W.; Taylor, J.W.; Lindle, D.W.; Grimm, F.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6201). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 1170-1185(1 Feb 1989).

Angle-resolved electron spectroscopy with the help of synchrotron radiation has been used to study resonant Auger processes near the core shells of Ar 2p, Kr 3d, and Xe 4d. Results for the lowest-energy resonances have received special attention: argon (Ar 2p/sub 3/2/→4s) at a photon energy of 244.4 eV, krypton (Kr 3d/sub 5/2/→5p) at 91.2 eV, and xenon (Xe 4d/sub 5/2/→6p) at 65.1 eV. The angular distribution parameters β are evaluated for each of the resolved Auger peaks. Most striking is the occurrence of large negative β values for some of the higher kinetic energy peaks. The results are most apparent under high electron resolution. The theoretical basis for having β values near -1 is discussed. In particular, the experimental results for argon are found to be in general agreement with the prediction of -1 β values by using either angular momentum transfer theory or normal Auger theory. However, a better understanding of the range of β values will have to await explicit calculations. Experimental results on the Auger spectra are also given at lower kinetic energies, for shakeup states, and for higher-energy resonances, especially those involving vacancies in the core shells of the lower spin states. It is shown that, although transitions having the same final state of the singly charged ion frequently have similar relative intensities and β values, occasionally they differ quite markedly. The theoretical consequences of variant behavior for processes having the same final states are also discussed.

16298 Quenching of low-lying Rydberg states of Na colliding with ground-state He: A semiclassical approach. Kumar, A.; Lane, N.F.; Kimura, M. (Department of Physics, Rice Quantum Institute, Rice University, Houston, Texas 77251). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 1020-1028(1 Feb 1989).

The molecular expansion method within the framework of the semiclassical approximation is applied to quenching of low-lying excited states of Rydberg atoms colliding with ground-state He at thermal energies. Interactions between the colliding atoms are accounted for in terms of pseudopotentials, and their relative motion is described by a classical linear trajectory. A fairly large basis set of Slater-type orbitals is used to obtain molecular eigenstates, and subsequently a 14-state close-coupling calculation is performed to evaluate the total quenching cross sections and the contributions of individual transitions. The energy dependence of the calculated cross sections is investigated, and possible mechanisms responsible for individual transitions are explained. Finally, the collision rates are calculated and compared with experimental results.

16299 **Electron-impact ionization of uranium atomic ions.** Pindzola, M.S.; Buie, M.J. (Department of Physics, Auburn University, Auburn, Alabama 36849). *Physical Review [Section] A: General Physics;* **39**: No. 3, 1029-1032(1 Feb 1989).

Electron-impact ionization cross sections for U/sup 16+/ and U/sup 82+/ are calculated in the distorted-wave approximation. Excitation-autoionization contributions are found to enhance the direct ionization cross section for U/sup 16+/ by a factor of 3 in the threshold energy region. Excellent agreement is found between the calculated total ionization cross section for U/sup 16+/ and recent crossed-beams experimental measurements. Only the direct ionization cross section for U/sup 82+/ is calculated since excitation-autoionization contributions are assumed to be small due to strong radiation field damping.

16300 **Collisional quenching of 2 ^{3}P and 2 ^{4}P states in 33-MeV two- and three-electron Mg ions.** Yu, G.; Watson, R.L.; Bandong, B.B.; Can, C.; Sampoll, G.; Moler, E.; Maurer, R.J. (Cyclotron Institute and Department of Chemistry, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] A: General Physics;* **39**: No. 3, 1041-1048(1 Feb 1989).

The spectra of Mg Kα x rays, emitted in collisions of 33-MeV Mg ions with noble-gas atoms, have been measured using a curved-crystal spectrometer. Quenching of the metastable 1s2p ^{3}P state of He-like Mg and the 1s2l2p ^{4}P states of Li-like Mg caused the intensities of x rays from these states to decrease, relative to the intensities of x rays from the promptly decaying ^{1}P and ^{2}P states as the gas pressure increased. Quenching cross sections were determined by fitting the observed pressure dependence of the x-ray intensity ratios to a function derived from the rate equation for the production and decay of these states, with additional terms to account for contributions from prompt spectator-electron transitions. The quenching cross sections for the ^{3}P state compare favorably with outer-shell electron-capture cross sections estimated from semiempirical scaling rules and recoil time-of-flight measurements.

16301 **Isotope shifts and hyperfine structure of Pt I transitions in a hollow-cathode discharge.** LaBelle, R.D.; Fairbank W.M. Jr.; Engleman R. Jr.; Keller, R.A. (Department of Physics, Colorado State University, Fort Collins, Colorado 80523). *Journal of the Optical Society of America B: Optical Physics;* **6**: No. 2, 137-141(Feb 1989).

Saturation spectroscopy in a hollow-cathode discharge is used to measure isotope shifts and hyperfine splittings for the 270.24 and 270.59-nm transitions in Pt I. From a systematic analysis of this and other data, the following relative changes in nuclear-charge ratios are derived: 192—190 = 0.8164(45), 194—192 = 0.8997(26), 196—194 = 0.9253(17), 198—196 = 1, and 195—194 = 0.4254(16). An improved value of 63.95(3) mK is also derived for the hyperfine constant A of the 37769-cm/sup -1/ state. These constants are also used to assess the accuracy of techniques for extracting centroids, hyperfine constants, and isotope shifts from Fourier-transform spectra.

16302 **Solvable approximate model for the harmonic radiation from atoms subjected to oscillatory electric fields.** Biedenharn, L.C.; Rinker, G.A.; Solem, J.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* **6**: No. 2, 221-227(Feb 1989).

We develop a nonperturbative model for the response of atomic electrons to oscillating external electric fields, valid in the physical regime where the central electric force is well described by an inverse square law and where the driven oscillations preserve the principal quantum number. We use the model to calculate the odd-harmonic radiation from a single atom driven by a laser field. The exact time-dependent eigensolutions of the model illustrate Zel'dovich's concept of quasi-energy for sinusoidally time-dependent Hamiltonians. The validity and applicability of the model and suggested improvements are briefly discussed.

16303 **Calculation of the first-order s-wave optical potential in pionic atoms.** Garcriaaa-Recio, C.; Salcedo, L.L.; Oset, E. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 595-607(Feb 1989).

A microscopic calculation of the first-order s-wave optical potential in pionic atoms which allows the inclusion of the off-shell dependence in momentum of the s-wave πN amplitude is carried out. Binding effects are also properly taken into account. The results obtained, together with those of the second-order optical potential, are in disagreement with phenomenological optical potentials. The results of the paper suggest the need of new and precise experiments on πN scattering at low energies and other experiments which can provide precise values of the πN scattering lengths.

16304 **Calculations of multiple-harmonic conversion of 1064 nm radiation in Xe.** Kulander, K.C.; Shore, B.W. (Theoretical Atomic and Molecular Physics Group, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **62**: No. 5, 524-526(30 Jan 1989).

The relative strengths of harmonic intensities, generated in xenon by a strong infrared laser, are calculated from the time-dependent dynamics of the electronic charge density. The (nonperturbative) solution of the time-dependent Schroedinger equation for a single-electron model of the atomic system is found to predict line strengths in reasonable agreement with the observed intensities. A single time-dependent calculation provides the intensity predictions for all orders for a given laser wavelength and intensity.

16305 **Low-energy features of the e^--H(n = 2) system exhibited in fast H^- detachment collisions.** Liu, C.; Starace, A.F. (Department of Physics and Astronomy, The University of Nebraska, Lincoln, Nebraska 68588-0111). *Physical Review Letters;* **62**: No. 4, 407-410(23 Jan 1989).

Quantitative predictions for the doubly differential detachment collisions, 0.5-MeV $H^- + He \rightarrow H\ (n = 2) + He/sup\ */+e^-$, are provided by use of hyperspherical wave functions for the H-e^- system. Individual H-e^- hyperspherical channels are identified as producing distinct "cusp," "shape resonance," and/or "shoulder" features in the laboratory-frame cross sections. Moreover, the first quantitative predictions of the expected Gailitis-Damburg dipole-field—induced oscillations in the cross sections above the H(n = 2) threshold are presented and distinguished from $^1P^o$ shape resonance effects.

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REFER ALSO TO CITATION(S) 16272

16306 **(CONF-880713—22) Review of intense electron beam transport in gases.** Destler, W.W.; Rodgers, J.; Segalov, Z.; Striffler, C.D.; Yao, R.L.; Zhang, X.; Guillory, J. (Maryland Univ., College Park (USA)). 1988. Contract AC05-85ER40216. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005397/JAW.

From Beams '88: 7th international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

In this review, recent results from three different experimental configurations will be discussed. In the first, intense electron beams are injected into gas-filled drift tubes and ionization of the gas at the beamfront results in the creation of a neutralizing plasma channel that allows for effective beam propagation. In the second configuration, a preformed plasma channel is produced by various methods in the drift tube. In this manner beamfront erosion can be significantly reduced and transverse instabilities can be suppressed. In the third configuration, intense electron beams are injected through a localized plasma into vacuum. Beam space charge effects accelerate ions downstream where they provide a channel of neutralization that permits effective electron beam propagation into the vacuum region. In this paper theoretical considerations and recent experimental results pertaining to intense beam propagation in gases

and background plasmas are summarized. A more detailed presentation is given of the third configuration. 28 refs., 5 figs.

16307 **(ITEP—63(1988)) Conservation of topological invariants of magnetic field in magnetohydrodynamics.** Monastyrskij, M.I.; Sasorov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705553/JAW.

A definition of force line reconnection is proposed within the framework of the ideal magnetohydrodynamics (Re/sub m/ >> 1). By the definition it is proved that (unic) the asymptotic Hopf invariant is conserved within an interval t which is much smaller than the skin (diffusion) time t/sub d/. For smooth flow of an ideally conducting fluid a method is proposed for determining the linked force line invariants which differ from the Hopf invariant. 11 refs.; 1 fig.

16308 **(SAND—88-7151) Aerodynamics of two-dimensional slotted bluff bodies.** Takahashi, F.; Higuchi, H. (Sandia National Labs., Albuquerque, NM (USA); Minnesota Univ., Minneapolis (USA). Dept. of Aerospace Engineering and Mechanics). 30 Apr 1988. Contract AC04-76DP00789. 131p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007288/JAW.

Aerodynamic characteristics of two-dimensional, slotted bluff bodies were experimentally investigated. Flow visualizations, base pressure measurements, mean velocity vector measurements, and drag force measurements were conducted to analyze effects of spacing ratio (i.e., porosity), curvature, and vent. Low porosity model configurations produced stable near-wake patterns with enhanced vortex sheddings of overall wake formations. Model curvature reduced drag forces and weakened the vortex sheddings. Stabilizing effect of curvature on the near-wake patterns was also found. A vent combined with large model curvature was found to control drag force effectively, as well as suppressing vortex sheddings. 10 refs., 52 figs., 1 tab.

16309 **(UCRL—100098) Numerical simulation of turbulent mixing in shock-tube experiments.** Mikaelian, K.O. (Lawrence Livermore National Lab., CA (USA)). 28 Nov 1988. Contract W-7405-ENG-48. 11p. (CONF-8810234—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005101/JAW.

From Workshop on the physics of compressible turbulent mixing; Princeton, NJ, USA (24 Oct 1988).

We have carried out a number of 2D numerical simulations on an ALE code for shock-tube experiments in which a shock crosses one or more contact discontinuities and, after traveling through a homogeneous medium, reflects off a rigid wall at the end of the shock-tube and re-crosses the contact discontinuity. We have considered two-fluid and three-fluid experiments: the first fluid, which carries the original shock, is air; the other fluids are helium, freon, SF_6, or air again. Helium is lighter than air, while freon and SF_6 are heavier than air. The interface(s) between the fluids serve as contact discontinuities and are subjected to the original shock, the re-shock, and subsequent rarefactions/compressions. 9 refs., 6 figs.

16310 **Electron attachment and ionization coefficients and electron drift velocities in BF_3 and SiF_4.** Hunter, S.R.; Carter, J.G.; Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **65**: No. 5, 1858-1865(1 Mar 1989).

The drift velocity of electrons (w) in SiF_4 and BF_3 has been measured over the density-reduced electric field (E/N) range 0.5 x 10/sup -17/ V cm^2 ≦E/N≦300 x 10/sup -17/ V cm^2 using a pulsed Townsend experimental technique. The electron attachment (eta/N) and ionization (α/N) coefficients have also been measured in SiF_4 and BF_3 over the E/N range 30 x 10/sup -17/ V cm^2 ≦E/N≦300 x 10/sup -17/ V cm^2 in the same experiment. The electron drift velocities in these two gases exhibit regions of negative differential conductivity (NDC) similar to but smaller in magnitude than those in CH_4 and CF_4. The effective ionization coefficient (alpha-bar/N) has been obtained from the eta/N and α/N measurements in both gases, from which the high-voltage limiting electric field strengths (E/N)/sub lim/ have been found to be 123 x 10/sup -17/ V cm^2 for BF_3 and 121 x 10^{-17} V cm^2 for SiF_4. The significance of these results in modeling gas discharges for a number of technological applications is indicated.

16311 **Enhanced separation of diffusing particles by chaotic advection.** Aref, H.; Jones, S.W. (Department of Applied Mechanics and Engineering Science and Institute of Geophysics and Planetary Physics, University of California, San Diego, La Jolla, California 92093). *Physics of Fluids A: Fluid Dynamics;* **1**: No. 3, 470-474(Mar 1989).

Combining the reversibility of advection by a Stokes flow with the irreversibility of diffusion leads to a separation strategy for diffusing substances. This basic idea goes back to Taylor and Heller. It is shown here that the sensitivity of the method can be greatly enhanced by making the advection chaotic. The separation is particularly efficient when the thinnest structures resulting from advection are made comparable in size to a diffusion length. Simple heuristic estimates based on an understanding of chaotic motion and diffusion lead to a certain scaling that is seen in numerical experiments on this separation method.

16312 **Study of waves on thin liquid films sheared by turbulent gas flows.** Jurman, L.A.; McCready, M.J. (Department of Chemical Engineering, University of Notre Dame, Notre Dame, Indiana 46556). *Physics of Fluids A: Fluid Dynamics;* **1**: No. 3, 522-536(Mar 1989).

Waves that occur at the interface of a thin, horizontal liquid film sheared by a concurrent turbulent gas flow are investigated. Observations using liquids in the range of 13—15 cP indicate that broad-crested, steady, periodic waves appear as the gas velocity is increased above the point of neutral stability. For a sufficiently large gas Reynolds number, steady solitary waves appear. These travel at speeds significantly faster than the periodic waves. However, if the liquid flow rate is increased, solitary waves do not form. To quantitatively describe the waves, a weakly nonlinear wave equation is derived using boundary-layer approximations. The equation is valid for liquid Reynolds numbers of O (1—100) and reveals the presence of both kinematic and dynamic processes, which may (i) act together or (ii) singularly dominate the wave field. For the latter case, reduced forms of the evolution equation are derived. Linear stability analysis of the complete equation and its reduced forms is used to determine the parameter ranges where either dynamic or kinematic processes dominate. The evolution equation in its nonlinear forms should be capable of describing and predicting the amplitudes, shapes, and interactions of finite amplitude waves.

16313 **On the validity of Taylor's hypothesis for wall-bounded flows.** Piomelli, U.; Balint, J.; Wallace, J.M. (Department of Mechanical Engineering, University of Maryland, College Park, Maryland 20742). *Physics of Fluids A: Fluid Dynamics;* **1**: No. 3, 609-611(Mar 1989).

The results of large eddy simulation (LES) of the Navier—Stokes equations are used to evaluate the validity of Taylor's hypothesis of frozen turbulence, which states that the time derivative of some instantaneous quantity is proportional to its derivative in the streamwise direction, for incompressible plane channel flow. Time and space derivatives in the streamwise direction of the velocity components are, in fact, found to be well correlated. Root-mean-square fluctuations of the terms in Taylor's hypothesis also support the validity of this hypothesis above the buffer layer. The good agreement between LES and experimental results indicates that errors in the evaluation of derivatives in the streamwise direction are due mostly to insufficient resolution.

16314 **Evolution of the coupled Benard-Marangoni convection.** Oron, A.; Rosenau, P. (Department of Mechanical Engineering, Technion-Israel Institute of Technology, Haifa 32000, Israel). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 4, 2063-2069(15 Feb 1989).

A weakly nonlinear theory that describes the onset of the combined Benard-Marangoni convection is presented. All relevant

transport coefficients are taken to be temperature dependent. When the boundaries are, thermally, nearly insulating, the instability is weak and the perturbed fluid-air interface is found to be proportional to the temperature field F(zeta,tau) which evolves according to F/sub tau/-π_1(F/sub zeta/)/sub zeta/^{3}-π_2 (F/sub zeta/)/sub zeta//sub zeta/^{2}+π_3F/sub zeta//sub zeta//sub zeta//sub zeta/ +π_4F/sub zeta//sub zeta/+π_5 (F/sub zeta/)^2+π_6(F^2)/sub zeta// sub zeta/ +π_7(F^2)/sub zeta/+(β_1 +β_2)F = 0 where β/sub i/ are the Biot numbers, and π/sub i/, i = 1,...,7, are constants.

16315 **Fluctuations and dissipation in a fluid under shear: Linear dynamics.** Lutsko, J.F.; Dufty, J.W.; Das, S.P. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 1311-1324(1 Feb 1989).

A set of nonlinear Langevin equations for fluctuations of the local conserved densities in a fluid under shear is proposed. These equations are a model for the extension of hydrodynamics to very short wavelengths at liquid densities. The hydrodynamic modes associated with the linearized equations are studied as a function of wave vector and shear rate. The degeneracy of the viscous shear modes is lifted by the shear, and one of these modes combines with the heat mode to form a propagating pair. As an example of nonequilibrium fluctuations, the dynamic structure factor is calculated for several values of frequency and wave vector. At large shear rates one pair of propagating modes becomes unstable at a wavelength of the order of the particle size. This instability is suggested as a possible explanation for a shear-induced disorder-order transition seen in computer simulations. Nonlinear mode-coupling effects are studied elsewhere.

16316 **Viscoelasticity near the sol-gel transition.** Martin, J.E.; Adolf, D.; Wilcoxon, J.P. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 3, 1325-1332(1 Feb 1989).

Measurements of viscoelastic properties near the sol-gel transition demonstrate that viscoelastic phenomena are described by power laws. To describe these phenomena, we derive the distribution of relaxation times for branched polymers, both in the reaction bath and in the dilute solution. From this spectrum we can compute viscoelastic properties such as the shear relaxation modulus G(t) and the complex shear modulus G(ω). Near the gel point we find G(t)~t^{-}/sup Δ/, with Δ a universal exponent, for times that are small compared to a divergent time tau/sub z/: For longer times the decay is a stretched exponential. The exponent Δ is found to be sensitive to dilution. Likewise, the storage and loss parts of the complex shear modulus are found to scale as ω/sup Δ/. These results for the dynamics lead to a theory for the critical growth of the equilibrium shear modulus E above the gel point, and the divergence of the steady-state creep compliance J/sub e/^{0} above the gel point. Finally, we discuss the concentration dependence of the viscosity of a solution of branched polymers.

16317 **Path-integral simulation of the superfluid transition in two-dimensional ^{4}He.** Ceperley, D.M.; Pollock, E.L. (National Center for Supercomputer Applications, Department of Physics, University of Illinois, Champaign, Illinois 61820). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2084-2093(1 Feb 1989).

The superfluid transition in a two-dimensional ^{4}He system has been studied using computational-path-integral methods. Thermodynamic and structural properties, the single-particle momentum distribution, the one-particle off-diagonal density matrix (or order-parameter correlation function), the momentum correlations, the superfluid density (based on the winding-number distribution) and the vorticity correlation function were calculated for temperatures above and below the superfluid transition for a film density of 0.0432 A/sup -2/ (which corresponds to zero pressure in the ground state). The order-parameter correlation function shows an algebraic decay in good agreement with spin-wave theory. An indirect estimate based on an analysis of finite-size effects using the Kosterlitz-Thouless recursion relations leads to a vortex diameter of 3.7 +- 0.4 A, a vortex core energy of 2.7 +- 0.2 K and a critical temperature of 0.72 +- 0.02 K.

16318 **Shock-vortex interaction in superfluid helium.** Torczynski, J.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 4, 2165-2172(1 Feb 1989).

Some previously reported second-sound shock-wave experiments in rotating frames of reference are analyzed using the Schwarz localized-induction-approximation description of the motion of quantized vortices in superfluid helium. A linear-characteristic theory to describe the evolution of the wave is developed which incorporates the nonlinear and intrinsically nonsteady growth of helical perturbations on quantized vortex lines and their interaction with and degradation of the shock-induced counterflow velocity field. This analysis provides an explanation of the seemingly paradoxical experimental results, and numerical calculations based on the theory are in reasonable quantitative agreement with the experimental data.

16319 **Energetics and structure of ^{4}He droplets at a finite temperature.** Cleveland, C.L.; Landman, U.; Barnett, R.N. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 117-123(1 Jan 1989).

Bound quantum-liquid (^{4}He)/sub n/ droplets (n = 57, 120, and 270) at 3 K coexisting with saturated vapor are studied with use of quantum path-integral molecular dynamics. The diffuse nature of the droplets and their pachydermatous behavior extends to larger sizes in comparison to the corresponding clusters at zero temperature. For the largest droplet a core liquid region develops, exhibiting properties in agreement with bulk data.

6450 High Energy Physics

16320 **(CRN-CPR—88-01) Possibilities offered by simultaneous use of PIXE and PIGE methods in elementary analysis.** Bordas, M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jan 1988. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756668/JAW.

The PIGE method applied to the analysis of the light elements Li, B, F, Na, Al, and Si using protons was evaluated. For the quantitative analysis, the models of Ishii et al (1978) of activation by accelerated particles are used. The PIXE and PIGE methods were used simultaneously to analyse standard glasses and obsidians. For PIGE analysis, the Ishii model is an excellent approximation and gives precise results for certain cases. For PIXE, assimilation of light elements (Z<13) to oxygen does not introduce any significant error for Z<20 elements. For the others, deviations are observed, especially for high concentrations of light elements. Simultaneous use of the two methods allows the range of elements analyzed to be extended, and stopping power to be calculated. It is limited by the fact that the number of nuclear reactions which can be used is defined by the projectile. Thus in the present case based on the use of 1 to 3.5 MeV protons, analysis of N and 0 is excluded.

16321 **(DOE/ER/10587—7) Theoretical high energy physics research at the University of Chicago: Technical progress report, April 1, 1988--March 31, 1989.** Rosner, J.L.; Sachs, R.G. (Chicago Univ., IL (USA)). Dec 1988. Contract AC02-80ER10587. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Numbe· DE89006410/JAW.

This paper briefly discusses topics in high energy physics in the following areas: hadron spectroscopy; collider physics; CP violation; minor fermions; field theories; string dynamics; radiative kaon decays; electromagnetic properties of baryons; electric dipole moments of the neutron; and high temperature superconductivity. (LSP)

16322 **(DOE/FTR—9007340) [9th meeting of the US/PRC Joint Committee for Cooperation in High Energy Physics, Beijing, China, and visit to KEK, Tusukuba, Japan, October 20--27, 1988]: Foreign trip report.** Samios, N.P. (Brookhaven National Lab., Upton, NY (USA)). 13 Feb 1989. Contract AC02-76CH00016. 3p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007340/JAW.

The 9th Meeting of the US/PRC JCC for High Energy Physics was held in accord with the agreement between the United States and People's Republic of China on Cooperation in Science and Technology. The purpose of this meeting was to discuss the on-going collaboration on high energy physics. The United States and Chinese delegations met for two days and discussed in detail the proposed program of collaborative work for the next fiscal year. A day was spent visiting the National Laboratory for High Energy Physics (KEK) in Tsukuba, Japan. The purpose was to inspect the TRISTAN Lab, the accelerator and detectors as well as to have discussions with Drs. Nishikawa, Sugawara and Ozaki.

16323 **(DOE/FTR—9007342) [Third Pan American symposium on collaboration in physics, Rio de Janeiro, Brazil, October 17--23, 1987]: Foreign trip report.** Samios, N.P. (Brookhaven National Lab., Upton, NY (USA)). 9 Feb 1989. Contract AC02-76CH00016. 3p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89007342/JAW.

The aim of this Symposium was to review the status of high energy particle physics together with a general survey of other fields of physics with emphasis on increasing Latin-American participation in the science and in associated technology.

16324 **(SLAC-PUB—4736) The physics of heavy flavors.** Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 50p. (CONF-8808182—1). NTIS, PC A03 - OSTI. Order Number DE89006062/JAW.

From Heavy flavor physics symposium; Beijing, China (10 Aug 1988).

Various aspects of the physics of heavy flavors and of CP violation are reviewed. 102 refs., 21 figs.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 15787, 16179, 16227, 16254, 16455

16325 **(BNL—42143) Mass dependent fits of the partial wave analysis of the K^+{bar K}$^0\pi$/sup {minus}/ system.** Blessing, S.; Crittenden, R.; Dzierba, A.; Marshall, T.; Teige, S.; Zieminska, D.; Birman, A.; Chung, S.U.; Peaslee, D.; Fernow, R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880862—11). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006181/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

We have performed a partial wave analysis of the K$^+$K/sub S/$^0\pi$/sup {minus}/ system produced in the reaction π/sup {minus}/p $\rightarrow$ K$^+${bar K}$^0\pi$/sup {minus}/n at 8 GeV/c. We present the mass dependent fits to the PWA results for the waves J/sup PG/(isobar) = 0/sup {minus}+/(a_0), 0/sup {minus}+/(K*), 1^{++}(a_0) and 1^{++}(K*). 4 refs., 5 figs., 1 tab.

16326 **(BNL—42149) Kaons, hyperphotons, and the fifth force.** Aronson, S.H.; Cheng, Hai Yang; Fischbach, E.; Sudarsky, D.; Talmadge, C.; Trampetic, J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-8808145—25). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006175/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

After briefly reviewing the status of recent experiments looking for the fifth force in ordinary matter, we discuss two classes of experiments sensitive to the presence of a coupling of kaons to the fifth force. These are attempts to detect hyperphotons (γ/sub Y/) in the decay K/sub L/ $\rightarrow \pi^+\pi^-\gamma$/sub Y/, and searches for an energy-dependence of the K^0 - {bar K{sup 0}} parameters. 29 refs.

16327 **(CEA-N—2572) Charm photoproduction. Decays and time of life of the strange-charm meson.** Magneville C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1988. 290p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88756431/JAW.

In this thesis, decays and lifetimes of the charmed D/sup +-/ and F mesons have been studied, using the datas of the NA14-2 experiment at CERN. We have filtered events with two kaons of opposite signs. We have used a silicon vertex detector, which consists of an active target and microstrips planes, in order to reconstruct and separate the interaction vertex from the decay vertex. Cuts on distance of flight have been made. This has allowed a good rejection of combinatorial background and the extraction of clean D/sup +-/, F (in KKπ) and Λ/sub c/ (in pKπ) signals. We measure their times of flight and compare to the theoretical predictions.

16328 **(CONF-8709147—13) D^0 {minus} {bar D}{Sup 0} mixing: The experimental situation.** Gladding, G. (Illinois Univ., Urbana (USA). Dept. of Physics). 1987. Contract AC02-76ER01195. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004352/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

D^0 {minus} {bar D}^{0} mixing, the extent to which the flavor eigenstate D^0 is not a mass eigenstate, is expected to be quite small in the standard model. Consequently, any evidence for the existence of D^0 {minus} {bar D}^{0} mixing at the currently experimentally accessible levels would indicate the need for explanations invoking new physics. In this report, I will review the current experimental situation. 8 refs., 8 figs.

16329 **(DOE/ER/10587—T7) Search for CPT violation in the neutral kaon system and a high sensitivity search for K/sub L/ $\rightarrow \pi^0e^+e^-$: Progress report, August 1, 1988--March 31, 1989.** Wah, Yau W. (Chicago Univ., IL (USA). Enrico Fermi Inst.). Dec 1988. Contract AC02-80ER10587. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006373/JAW.

Fermilab experiment E-773 with the goal of measuring the phase difference between {phi}^{00} and {phi}$^{+-}$ to better than . 5^0 is scheduled to run at March 1990 for two months. This precision measurement will improve the world limit by more than an order of magnitude. A letter of intent (P-799) with the goal of searching for the rare decay mode K/sub L/ $\rightarrow \pi^0e^+e^-$ with a sensitivity of $< 10^{-11}$ was submitted to Fermilab in October 1988. The formal proposal will be submitted in January 1989. The world best limit B.R.(K/sub L/ $\rightarrow \pi^0e^+e^- < 4 \times 10^{-8}$) which came from the E-731 data was published recently by the same group. There are two equipment construction projects currently being carried out; the track-processor and the transition radiation detector. Both are discussed in this paper.

16330 **(DOE/ER/40457—1) Fermilab Experiment E705: Status report.** Judd, D.J. (Prairie View A and M Univ., TX (USA)). 1988. Contract AS05-88ER40457. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006434/JAW.

During the fixed target run Fermilab Experiment E705, operating in the High Intensity Laboratory of the Proton Area with a large aperture, open geometry spectrometer took data with a variety of 300 GeV/c beams (π^+, π/sup {minus}/, proton and antiproton) on a Li7 target accumulating high statistics on hadroproduction of charmonium and high P/sub t/ direct photons. The E705 spectrometer operated at interaction rates up to one MHz during this run taking over 7500 data tapes containing approximately 200 million di-muon and high P/sub T/ photon triggers. The major components of this spectrometer consisted of a wire chamber system containing both drift and proportional wire chambers, a high resolution electromagnetic detector made from scintillation and lead glasses, and a large muon detector coupled to a sophisti-

cated multi-stage muon trigger. The prime objectives of the experiment were the measurement of the hadroproduction of the ^3P states of charmonium system. This is discussed in this paper.

16331 **(FNAL/C—88/199-E) Quark gluon plasma: Overview and experimental results from E-735.** Turkot, F.; Alexopoulos, T.; Allen, C.; Anderson, E.W.; Areti, H.; Banerjee, S.; Beery, P.D.; Biswas, N.N.; Bujak, A.; Carmony, D.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 14 Dec 1988. Contract AC02-76CH03000. 18p. (CONF-8806232—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006141/JAW.

From 7. topical workshop on proton-antiproton collider physics; Batavia, IL, USA (20 Jun 1988).

A brief review of the phenomenology associated with the effort to produce and observe quark-gluon plasma in particle collisions is presented. E-735 has taken data during the 1987 Tevatron-Collider run at {square←root}s = 1.8 TeV in pursuit of this goal. Results in the correlation of < p/sub t/ > with multiplicity for charged particles and p/sub t/ distributions for Λ/sup o/ and {bar Lambda}/sup o/ are presented. 32 refs., 10 figs., 2 tabs.

16332 **(FNAL/C—88/200-E) Charm physics.** Purohit, M.V. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1988. Contract AC02-76CH03000. 10p. (CONF-880862—13). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006140/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

The status of charm physics with emphasis on recent high statistics results from fixed target experiments is presented. The topics covered include charm production, D^0{bar D}^{0} mixing, charm baryons and excited states such as the D**. Also reviewed are charm decays: hadronic, leptonic as well as semileptonic. Finally, we take a brief look at charm lifetimes before concluding with a look to the future. 28 refs., 2 figs., 1 tab.

16333 (GSI—88-68-Prepr., pp 7-10) **Experiments on low energy Bhabha scattering search for neutral resonances in the MeV/c/sup 2/ mass region.** Kozhuharov, C. Dec 1988. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756804/JAW. (CONF-880867—).

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

The author presents a short review about the search for the e/sup +/e/sup -/ decay of a postulated neutral boson by means of low-energy Bhabha scattering. The obtained limits on mass and Γ/sub ee/Γ/sub γγ//Γ are presented. (HSI).

16334 **(IFVE-OEF—88-100) Production of large transverse momentum hadrons in hadron-nucleus collisions.** Sulyaev, R.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705481/JAW.

Report on 9. International conference on high-energy physics problems. Relativistic nuclear physics and quantum chromodynamics. Dubna, 1988.

General experimental data on high hadron production with large transverse momentum p/sub t/ in proton-nucleus and pion nucleus collisions in the 70-800 GeV energy range are reviewed. The data include the information on inclusive cross sections of hadron production, cross sections of high p/sub t/ hadron pair production and its dependence on atomic number A. The results on study of processes of hadron production off nuclei at large transverse energy E/sub t/ and jet production at 800 GeV are are also presented. The experimental data are analyzed in the framework of quark-parton models. 35 refs.; 17 figs.

16335 **(IFVE-ONF—88-101) Analysis of inclusive direct muon production in pFe interactions at 70 GeV.** Sviridov, Yu.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 16p. (In Russian). (SERP-E—114). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705483/JAW.

Submitted to the journal Sov. J. Nucl. Physl. .

The analysis of inclusive prompt muons production in the proton beam-dump experiment is performed. On the basis of this analysis the model-dependent estimates of the cross-section for charmed particles production in pFe-collisions at $\sqrt{}=11.5$ GeV are obtained. 19 refs.; 6 figs.; 2 tabs.

16336 **(IFVE-OTF—88-67) Are the gluon distributions different in π- and K-mesons?.** Batunin, A.V.; Likhoded, A.K.; Kiselev, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705485/JAW.

The experimental data an excess of D-meson production in K/sup -/-beam as compared with π/sup -/ one (NA32 collaboration) is discussed. Such a situation is shown to be possible at larger total number of gluons in K-meson only. However, this is in a disagreemtn with other charm production experiments. 12 refs.; 4 figs.

16337 **(LAL—87-52) Hadro and Photoproduction of c and b Hadrons.** D'Almagne, B. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Nov 1987. 21p. (CONF-8709147—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756685/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

Results in heavy flavor spectroscopy and decay; the baryon sector; lifetimes; and weak decays are reviewed. Charm hadroproduction dynamics (cross section dependence, total charm production cross sections, differential cross sections) are discussed. Charm photoproduction dynamics (A dependence, total cross sections, production characteristics) are considered. Open beauty production in hadron or photon interactions (B production in fixed target experiments and at colliders) is treated.

16338 **(PCCF-T—87-02) J/PSI decay in pseudoscalar and vectorial mesons associated to a pantip pair at DCI-Orsay. Research of etac.** Dekmouche, A. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire; Clermont-Ferrand-2 Univ., 63 - Aubiere (France)). Jun 1987. 137p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756446/JAW.

The proton-antiproton system associated to meson or a photon in the J/PSI decays is studied using the sample of 8.6 millions of J/PSI provided by the e/sup +/e/sup -/ collider DCI at Orsay. The particles resulting from these decays are detected with the DM2 detector. (18 +- 5) events from the final state γetac (etac->pantip) have been observed. They correspond to a Branching Ratio (1.4+-0.4+-0.3) x 10/sup -5/ which is the smallest one measured in the J/PSI decays. Also included in this study is the radiative decay J/PSI->γpantip. Its Branching Ratio has been compared with the results obtained by the Quantum Chromodynamics theoretical estimates. The final states rho/sup 0/pantip, ωpantip, etapantip, eta'pantip and π/sup 0/pantip are measured and qualitatively explained in the framework of our present knowledge of Strong Interaction mechanisms. Ultimately, a large production of N* is observed in the decay J/PSI -> anti N* + cc (N* -> pπ/sup 0/, peta).

16339 **(SLAC-PUB—4748) Searching for an exotic lepton and gauge boson at high energy e^+e/sup {minus}/ colliders.** Gan, K.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 4p. (CONF-8806243—29). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007546/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

The possibility of searching in high energy e^+e/sup {minus}/ collisions for a singly produced heavy with an ordinary light lepton, e^+e/sup {minus}/ → L^+{ell}/sup {minus}/, has been investigated. The search is motivated mainly by its distinctive experimental signatures. In a data sample corresponding to an integrated luminosity of 30 fb/sup {minus}1/ collected at a 1 TeV e^+e/sup {minus}/ collider, the search is sensitive to a lepton of

mass up to about 1 TeV/c^2 and a production cross section as low as 10% of the μ-pair point cross section. For the case where the process is mediated by an exotic gauge boson, sensitivity to a gauge boson of mass up to about 2 TeV/c^2 can be achieved. 5 refs., 7 figs., 2 tabs.

16340 **(SLAC-PUB—4855) Tau physics and tau factories.** Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 16p. (CONF-8811125—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007539/JAW.

From Rare decay symposium; Vancouver, Canada (30 Nov 1988).

Substantial progress in tau lepton physics requires larger and cleaner samples of {tau}'s produced in e^+e/sup minus/ $\rightarrow$ {tau}$^+${tau}/sup minus/. Single-tagging of the {tau} pair is crucial. Possibilities for such progress at particle factories are discussed with emphasis on the Tau-Charm Factory concept. 30 refs., 1 fig., 1 tab.

16341 **Measuring CP violation in the B^0B-bar^0 system with asymmetric-energy e^+e^- beams.** Aleksan, R.; Bartelt, J.; Burchat, P.R.; Seiden, A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *Physical Review [Section] D: Particles and Fields;* **39**: No. 5, 1283-1296(1 Mar 1989).

We have studied in some detail the possibility of observing CP violation in the B-meson system using asymmetric-energy e^+e^- beams colliding with a center-of-mass energy corresponding to the Y(4S) mass. If a CP eigenstate is detected in conjunction with an identified B^0 or B-bar^0, the distribution of the flight path between decays contains a term which provides a measurement of CP violation, as discussed in this paper. The moving B mesons in the laboratory make this flight-path measurement possible. The use of the Y(4S) provides the largest BB-bar cross section in e^+e^- production, other than from the Z^0, and allows excellent background rejection because the B is monoenergetic in the center-of-mass frame. Since there are no extra fragmentation products accompanying the BB-bar in the event, very simple tagging strategies can be used to separate B^0 from B-bar^0 decays, providing a tagging efficiency close to 50%. The CP eigenstates studied in this paper are J/psi+K/sub S/^{0}, J/psi+K/sup */^{0} and psi'+K/sub S/^{0}. Given an adequate detector, the integrated luminosity needed to observe CP violation in the standard model is expected to be about 2 x 10/sup 40/ cm/sup -2/ or 10^7 produced B^0B-bar^0 pairs.

16342 **Experimental study of the semileptonic decay $D^+\rightarrow$K-bar$^0e^+\nu$/sub e/.** Anjos, J.C.; Appel, J.A.; Bean, A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Duboscq, J.E.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; and others. (University of California, Santa Barbara, California, 93106). *Physical Review Letters;* **62**: No. 7, 722-725(13 Feb 1989).

The decay $D^+\rightarrow K^-\pi^+e^+\nu$/sub e/ has been studied in the Fermilab photoproduction experiment E691. The ratio of branching ratios, B($D^+\rightarrow$K-bar/sup */$^0e^+\nu$/sub e/)/B ($D^+\rightarrow K^-\pi^+\pi^+$), is found to be 0.49 +- 0.04 +- 0.05, corresponding to a $D^+\rightarrow$K-bar/sup */$^0e^+\nu$/sub e/ branching ratio of (4.5 +- 0.7 +- 0.5)%. The branching ratio to the nonresonant ($K^-\pi^+$)/sub NR/eν/sub e/ final state is found to be less than 0.7% at the 90% confidence level. The K/sup */^{0} mesons have a ratio of longitudinal to transverse polarization of 2.4/sub -0.9//sup +1.7/ +- 0.2. .AE

16343 **Measurement of the inclusive jet cross section in p-barp collisions at $\sqrt{s}$ = 1.8 TeV.** Abe, F.; Amidei, D.; Apollinari, G.; Ascoli, G.; Atac, M.; Auchincloss, P.; Baden, A.R.; Barbaro-Galtieri, A.; Barnes, V.E.; Bedeschi, F.; and others. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **62**: No. 6, 613-616(6 Feb 1989).

Inclusive jet production at $\sqrt{s}$ = 1.8 TeV has been measured in the CDF detector at the Fermilab Tevatron pp-bar Collider. Jets with transverse energies (E/sub t/) up to 250 GeV have been observed. The E/sub t/ dependence of the inclusive jet cross section is consistent with leading-order quantum-chromodynamic calculations, and comparison with lower-energy data shows deviations from scaling consistent with QCD. A lower limit of 700 GeV (95% confidence level) is placed on the quark compositeness scale parameter Λ/sub c/ associated with an effective contact interaction.

16344 **Charm photoproduction.** Anjos, J.C.; Appel, J.A.; Bean, A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; Gibney, M.C.; and others. (University of California, Santa Barbara, California 93106). *Physical Review Letters;* **62**: No. 5, 513-516(30 Jan 1989).

We present results on the photoproduction of 10 000 charmed particles from the 10^8 recorded triggers of Fermilab experiment E691. The total cross section for the photoproduction of D^0 and D^+ particles (and antiparticles) for x/sub F/>0.2 is measured to be 3.88 +- 0.06 +- 0.40 μb/Be nucleus at <E/sub γ/> = 145 GeV. We have also measured the relative production of different charmed particles, their p/sub T/^{2} and x/sub F/ distributions, and the energy dependence of the total charm cross section. The mean p/sub T/^{2} is 1.16 +- 0.04 GeV^2/c^2 and the ratio of charm cross sections at 200 and 100 GeV is 1.96 +- 0.24. Results of fits to the x/sub F/ distribution are also reported.

16345 **Evidence for gluonium in J/psi decays.** Sadrozinski, H.F.W. (Santa Cruz Institute for Particle Physics, Univ. of California, Santa Cruz, CA (US));. pp v of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

Recent results from the MARK III experiment at SPEAR on J/PSI radiative and hadronic decays are presented. The mass spectra recoiling against the vector particles γ,ω,phi are investigated for evidence for gluonium production, and the status of the iota(1460) and θ(1720) as gluonium candidates are discussed.

16346 **Recent results on radiative J/PSI decays from Mark III.** Eigen, G. (California Institute of Technology, Pasadena, CA (US));. pp v of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

Recent results from the Mark III Collaboration on the radiative J/PSI decays J/PSI $\rightarrow \gamma$ phiphi and J/PSI $\rightarrow \gamma\omega$phi are presented. A significant structure is observed in the 2.1 to 2.4 Ge V region in the phiphi mass spectrum, yielding a product branching ratio of B(J/PSI $\rightarrow \gamma$X). B(X $\rightarrow$ phiphi = (4+-0.5+-0.8) X 10/sup -4/. In the radiative channel J/PSI $\rightarrow \gamma\omega$phi no significant signal is found.

16347 **Have we seen gluon-based hadrons? A survey as of June 1986.** Heusch, C.A. (Santa Cruz Institute for Particle Physics, Univ. of California, Santa Cruz, CA (US));. pp v of Proceedings of the XVII international symposium on multiparticle dynamics. Markytan, M.; Majerotto, W.; MacNaughton, J. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606203—).

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

The authors present a review of hadronic states that are seen as candidates for quarkless matter, at masses below 2.5 GeV/c/sup 2/. They attempt to use recent evidence from J/PSI decays, $\gamma\gamma$ collisions and hadronic interactions to disentangle some of the confusion surrounding the iota(1460), Θ(1700), and ν(2230) candidate states.

16348 **Evidence for a narrow massive state in the radiative decays of the upsilon.** Bloom, E.D. (Crystal Ball Collaboration (US));. pp v of Proceedings of the Yukon Advanced Study Institute on the quark structure of matter. Isgur, N.; Karl, G.; O'Donnell, P.J. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8408129—).

From Conference on the quark structure of matter; Scarborough, Ontario, Canada (11 Aug 1984).

Evidence is presented for a state, which the authors call zeta, with a mass M = (8322 +- 8 +- 24) MeV and a line width T < 80 MeV (90% confidence level) obtained using the Crystal Ball NaI(Tl) detector at DORIS II. Radiative transitions to this state are observed from about 100,000 Y(1S) decays in two independent sets of data: One in which zeta → multiple hadrons, and one which is strongly biased towards zeta → 2 low multiplicity jets. The branching ratio to this state from the Y(1S) is of order 0.5%.

16349 **Cygnium x-3, ultra-relativistic nuclear collisions, high density matter, and other stuff which we don't know too much about.** McLerran, L. (Theory Dept., Fermilab, P.O. Box 500, Batavia, IL (US));. pp v of Quark confinement and liberation: Numerical results and theory. Klinkhamer, F.R.; Halpern, M.B. Teaneck, NJ; World Scientific Pub. Co. (1985).

In this talk the author discusses striking features of QCD which have not yet either been fully experimentally verified, or in my opinion, satisfactorily computed in lattice gauge theory. He summarizes present qualitative and semi-quantitative insight into these features of QCD, and how these features might appear either naturally, or in controlled accelerator experiments.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 15467, 16303, 16377, 16378, 16379, 16379, 16396, 16397, 16397, 16402, 16405, 16408, 16511

16350 **(ANL-HEP-CP—88-73) Spin models of the proton.** Ramsey, G.P. (Argonne National Lab., IL (USA). High Energy Physics Div.). 20 Oct 1988. Contract W-31109-ENG-38. 16p. (CONF-880983—34). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005882/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

We have constructed a model of the proton spin based on a broken SU(6) parameterization for the spin-weighted valence quark distributions in a longitudinally polarized proton. The polarized sea and gluon distributions are assumed to have simple relations to the corresponding unpolarized structure functions. The sum rules, which involve the non-singlet components of the structure function xg_1, imply that the valence quarks carry about 78% of the proton spin, while the spin carried by sea quarks is negative. Recent EMC data suggest a model in which the sea quarks carry a large negative polarization, whereas certain theoretical arguments favor a model with a smaller negatively polarized sea. These models are discussed with reference to the sum rules. Experiments are suggested which will discriminate between these models. 24 refs., 4 figs.

16351 **(ANL-HEP-CP—88-74) Surprising theoretical results on the decay rate of the {tau} lepton.** Braaten, E. (Argonne National Lab., IL (USA)). 24 Oct 1988. Contract W-31109-ENG-38. 3p. (CONF-8808145—19). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005781/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

Corrections to the naive prediction for the inclusive semihadronic decay rate of the {tau} lepton contain several surprises: electroweak corrections are significant, nonperturbative QCD corrections can be treated systematically, and the order $\alpha/\text{sub } s/^2$ perturbative QCD corrections are enormous. The possibility of precise theoretical predictions of the decay rate is discussed. 10 refs.

16352 **(ANL-HEP-CP—88-80) The finite temperature behaviour of lattice QCD with moderate to large quark masses.** Sinclair, D.K. (Argonne National Lab., IL (USA). High Energy Physics Div.). 1988. Contract W-31109-ENG-38. 3p. (CONF-8809247—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004279/JAW.

From Lattice '88: symposium on lattice field theory; Batavia, IL, USA (22 Sep 1988).

Simulations of lattice QCD with 4 flavours of staggered quarks were performed using the Hybrid algorithm on a 12^3 {times} 4 lattice. For quark masses ≧.1 (lattice units) the finite temperature transition did not appear to be first order. 6 refs., 3 figs.

16353 **(ANL-HEP-CP—88-83) Analysis of a lattice Wess-Zumino scheme for chiral fermions.** Bodwin, G.T.; Kovacs, E.V. (Argonne National Lab., IL (USA). High Energy Physics Div.). 1988. Contract W-31109-ENG-38. 6p. (CONF-8809247—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004197/JAW.

From Lattice '88: symposium on lattice field theory; Batavia, IL, USA (22 Sep 1988).

We show that the four-dimensional version of the chiral lattice fermion scheme proposed by Aoki and Funakubo and Kashiwa leads, in the continuum limit, to a transverse, but quadratically divergent, contribution to the effective vacuum polarization. Hence, the scheme does not make sense without the addition of counterterms beyond those that are required in the continuum theory. 10 refs., 3 figs.

16354 (CONF-870155—, pp 227-242) **Long-range excitation of electron-hole pairs in atom-surface scattering.** Annett, J.F.; Echenique, P.M. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

The van der Waals potential of a neutral atom at rest outside a metal surface is a consequence of virtual excitations of the substrate and of the atom. If the atom is moving the van der Waals potential becomes complex, the imaginary part corresponding to real excitations of the substrate, e.g. excitation of electron-hole pairs on surface plasmons. Using a self-energy formulation of this complex van der Waals interaction we derive expressions for inelastic scattering probabilities of atoms or ions reflected from surfaces. In the case of ion scattering from surfaces this reproduces a well known result. For neutral atom scattering we calculate inelastic scattering probabilities for xenon atoms incident on metal surfaces at hyperthermal energies. We compare our results with the recent experiments of Amirav and Cardillo. 16 refs.

16355 **(DOE/ER/40141—4) Research in high energy theoretical physics: Progress report.** Clavelli, L.J.; Harms, B.C.; Jones, S.T. (Alabama Univ., University (USA). Dept. of Physics and Astronomy). 10 Dec 1987. Contract FG05-84ER40141. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007188/JAW.

This paper briefly discusses many papers submitted in theoretical High Energy Physics by the Physics Department of the University of Alabama. Most papers cover superstring theory, parity violations, and particle decay. (LSP)

16356 **(DOE/ER/40150—56) Meson exchange and the relativistic multiple scattering formalism.** Gross, F.; Maung, Khin Maung. (Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility). [1989]. Contract AC05-84ER40150. 12p. (CEBAF-PR—88-019). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006254/JAW.

A relativistic multiple scattering theory is formulated in the context of meson exchange. The elastic scattering amplitude for a fermion projectile satisfies a Dirac equation with an optical potential derived from a relativistic multiple scattering series. It is shown that two-body t-matrix associated with the optical potential is the one with the projectile on its mass-shell in all intermediate states. 8 refs., 3 figs.

16357 **(DOE/ER/40160—5) High energy hadron{endash}hadron collisions: Annual progress report.** Chou, T.T. (Georgia Univ., Athens (USA). Dept. of Physics and Astronomy). Jan 1989. Contract FG09-84ER40160. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006647/JAW.

Results of a study on high energy collision with the geometrical model are summarized in three parts: the elastic hadron-

hadron collision, the inelastic hadron{endash}hadron collision, and the e$^+$e/sup {minus}/ annihilation. The geometrical description of high-energy elastic scattering developed earlier is still in very good general agreement with experiments at the CERN{endash}S{bar←p}pS energies. This description has also been extended to include processes of fragmentation and diffraction dissociation and other phenomena. More recently a unified physical picture for multiparticle emission in hadron-hadron and e$^+$e/sup {minus}/ collisions was developed. It focuses on the idea of the wide range of values for the total angular momentum in hadron{endash}hadron collisions. An extension of this consideration yields a theory for the momentum distribution of the outgoing particles which agrees with {bar←p}p and e$^+$e/sup {minus}/ collision experiments. The results and conclusions if this theory have been extrapolated to higher energies and yielded many predictions which can be experimentally tested. 36 refs.

16358 **(FNAL/C—88/198-E) Theoretical implications of the W-Z mass difference and the capabilities of the D0 detector in measuring it.** Raja, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1988. Contract AC02-76CH03000. 22p. (CONF-8806232—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006142/JAW.

From 7. topical workshop on proton-antiproton collider physics; Batavia, IL, USA (20 Jun 1988).

We examine the phenomenology of the W-Z mass difference as a function of the top quark mass and the Higgs mass. A detailed analysis is presented on how well the mass difference is measurable using the D0 detector at Fermilab. We show that the effective mass distribution of the Z^0 is not a Breit-Wigner at the Tevatron and present techniques developed for the D0 detector simulation that can be used to reduce the systematic errors in measuring the W-Z mass difference. Scenarios are presented for the integrated luminosities of 10 pb^{-1} and 100 pb^{-1} at the Tevatron. It is shown that the Tevatron is competitive with LEP II for integrated luminosities of 100 pb^{-1} in attainable precisions in this measurement. These considerations argue strongly for the pp option in the Tevatron upgrade program. 17 refs., 14 figs., 2 tabs.

16359 **(IFT-P—17/88) Pion-cloud corrections to the relativistic S + V harmonic potential model.** Palladino, B.E.; Ferreira, P.L. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 20p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705469/JAW.

Pionic corrections to the mass spectrum of low-lying s-wave baryons are incorporated in a relativistic independent quark model with equally mixed Lorentz scalar and vector harmonic potentials. (M.W.O.).

16360 **(IFVE-OTF—88-95) Limitations on vacuum condensates from data on annihilation of e/sup +-/ -> hadrons.** Slobodenyuk, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705487/JAW.

The limitation on possible values for vacuum condensates of the operators with dimension d=4.6 have been obtained by means of Hilbert sum rules for quark electromagnetic current, where the experimentally measured cross section ratio of e/sup +/e/sup -/- annihilation in hadrons and μ/sup +/μ/sup -/ pairs was used as a spectral density. These limitations are strongly dependent on cutoff parameter Q/sub m//sup 2/, where the operator expansion fails. 4 refs.; 4 tabs.

16361 (INIS-SU—69, pp 39-41) **On nonpossibility of detonation phase transitions of quark-gluon plasma in hadrons.** Baranov, S.P.; Fil'kov, L.V. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.

In Experimental and theoretical physics. Collection.

The possibility of phase transition of the quark-gluon plasma in hadrons in the detonation regime is studied. It is shown that the account of entropy increase in the shock wave makes the transition of such a type impossible. 5 refs.; 1 fig.

16362 **(Juel-Spez—459) Kaon-nucleon interaction in the meson-exchange picture.** Buettgen, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bonn Univ. (Germany, F.R.)). Jul 1988. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756812/JAW.

In this thesis we dealt with the free kaon-nucleon interaction which was constructed analogously to the Bonn potential in the meson-exchange picture. Identical vertices in the NN and KN interaction are parametrized by equal coupling constants and cut-off masses. Under the assumption of a SU(3) invariant interactions relations between the coupling constants have been determined so that also the experimentally only roughly known coupling constants to the strange vertices are fixed. The remaining free cut-off masses in the kaon vertices are fitted to the empirical scattering data. On the base of one-particle exchange processes the contribution of higher-order diagrams (box potentials with intermediate NK/sup */ , ΔK/sup */, and ΔK states) in scattering phases, cross sections, and polarizations was studied. In the partial waves P/sub 13/ and D/sub 03/ the two-meson exchange processes lead to an essential improvement in the description of the empirical scattering phases. In the comparison of the calculated KN observables with the experimentally determined values (especially for the polarization in the elastic K/sup +/n channel) also the positive influence of the box potentials is shown. In the last part of the thesis for the similarly structured πN system it was studied whether here also the inclusion of uncorrelated two-meson exchange processes can remove the characteristical difficulties in the description of the empirical πN data. It results that the existing discrepancies between theoretical and empirical scattering phases can in this case not be removed by these higher-order processes. (orig./HSI).

16363 **(Juel-Spez—460) Meson-theoretical model of the hyperon-nucleon interaction.** Holzenkamp, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bonn Univ. (Germany, F.R.)). Jul 1988. 149p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756813/JAW.

We present a meson-exchange model for the hyperon-nucleon (ΛN and ΣN) interaction, which has been constructed according to the same guidelines as those used in the Bonn NN-potential. In contrast to the hyperon-nucleon coordinate space potentials of the Nijmegen group the model is given in momentum space and thus contains the full nonlocality structure predicted in the meson exchange framework. According to the importance of the Δ-isobar degree of freedom in the NN-channel, also in the hyperon nucleon systems we take into account higher order box-diagrams with the Δ and the corresponding strange spin-3/2 particle Y/sup */ in the intermediate states. The NN- and NΔ-vertex parameters (coupling constants and cutoff masses parametrizing the extended vertex structure) are taken from the Bonn-potential. The coupling constants at the strange vertices are determined from SU/sub 6/ symmetry relations whereas the corresponding cutoff masses are adjusted to the empirical hyperon-nucleon data. Effects arising from (a) Δ-isobar and Y/sup */ contributions, (b) the coulomb interaction and (c) the coupling of the two-particle channels ΛN and ΣN are investigated in detail. Within this model a good fit of the existing ΛN as well as ΣN data is achieved. In the scattering observables the coupled channel effect turns out to be of the order of 10%-15%. Somewhat larger effects arises from the contributions of the spin-3/2 baryons. The Coulomb interaction leads to a change in the total cross sections of 10%-20%. (orig./HSI).

16364 **(KFTI—87-57) Superparticle production in high-energy electron-proton collisions.** Boldyshev, V.F.; Rekalo, M.P.; Stoletnij, I.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705577/JAW.

The analytical formulae for total and differential cross sections of the ep -> e-tildey-tilde process, taking into account the polarization of both initial beams, are obtained. It is shown that the employment of longitudinally polarized initial beams provides a tool for varying relative contributions of left and right electrons superpartners and detecting their mass difference. 13 refs.; 2 figs.

16365 **(LA-UR—88-4197) Some recent results in hadronic physics with pions.** Gibbs, W.R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 25p. (CONF-8811146—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005465/JAW.

From LAMPF users group meeting; Los Alamos, NM, USA (1 Nov 1988).

Three topics in modern hadronic physics are developed with regard to their fundamental importance to our understanding of the strong interaction in general and nuclei in particular. These three subjects are: low energy pion-nucleon scattering and charge exchange, the study of the three nucleon system with elastic scattering of pions, and double charge exchange of pions on nuclei. In each case the studies are presented in terms of the fundamental motivations underlying them and the spectacular new data which is bringing new insight into these areas. 20 refs., 11 figs.

16366 **(RAL—88-089) Measurements of α/sub s/ in e/sup +/e/sup -/ interactions.** Marshall, R. (Rutherford Appleton Lab., Chilton (UK)). Oct 1988. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705589/JAW.

Determinations of α/sub s/ in e/sup +/e/sup -/ annihilation processes have shown a tendency in the past to fall into two categories: either the method is clean and the statistical accuracy is poor, or the statistical accuracy is excellent and the method is beset with (fragmentation) uncertainties. As long as the best fits to the differential distribution of data variables, using the best fragmentation models, have a chi/sup 2/ probability of no better than 1%, then the fragmentation model dependent determinations of α/sub s/ will always attract arguments, not to mention further discussion on the QCD matrix elements used in the Monte Carlo programs.

16367 **(SLAC-PUB—4819) The tau and beyond: Future research on heavy leptons.** Perl, M.I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1988. Contract AC03-76SF00515. 14p. (CONF-881073—2). NTIS, PC A03 - OSTI. Order Number DE89005963/JAW.

From Topical conference on physics in collision; Capri, Italy (19 Oct 1988).

This paper outlines directions for future experimental research on the tau and tau neutrino. Present limits on the existence of heavier charged leptons are reviewed, with emphasis on the close-mass lepton pair concept. 44 refs., 8 figs., 5 tabs.

16368 **P-wave pion scattering in the Los Alamos soliton model.** Bolsterli, M.; Parmentola, J.A. (T Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1304-1309(1 Mar 1989).

P-wave pion-nucleon scattering at low and intermediate energies has been calculated in the Los Alamos soliton model that describes the nucleon as a self-consistent soliton state of a dynamic QCD bag or core interacting with its pion field. The P-wave phase shifts in the 11 and 33 channels and the inelasticity in the 11 channel are computed within the subspace consisting of at most one physical pion plus one of three soliton states of the dynamic bag or core with its pion field. The soliton states used in the calculation are computed within an approximation that treats only pionic excitations of the self-consistent nontopological soliton ground state corresponding to the nucleon and neglects excited states of the core motion. Within this approximation, the soliton states used are the model's lowest two 11 states and lowest 33 state; these states can be thought of as the nucleon, Roper, and Δ states, where the latter two are in first approximation discrete states in the continuum. The coupling of the excited states to the continuum states gives the states a width in the usual way. The position of the 33 resonance is found to be sensitive to the value of the bag or core radius. The present approximate description of the scattering does not give a resonance in the 11 channel. The implications of these results for future work on the soliton model are discussed.

16369 **Quark momentum distribution of hadronic matter in a simple confining quark model.** Lissia, M.; Negele, J.W. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1413-1424(1 Mar 1989).

Exact calculation of the quark momentum distribution of a one-dimensional confining quark model of hadronic matter and comparison with approximations based on an effective hadronic theory provide an instructive, controlled test of the approximations commonly used in describing quark degrees of freedom in nuclei. The hadron-hadron correlation function in the effective theory when corrected for quark antisymmetry agrees well with that in the exact ground state. The package or convolution approximation, which approximates the quark wave function by the product of the many-hadron wave function multiplied by the ground-state wave function for the quarks in each hadron, is shown to produce a poor description of the quark momentum distribution and appropriate antisymmetrization of this product is shown to yield an excellent approximation at densities relevant to nuclear matter.

16370 **Probing the Earth with weakly interacting massive particles.** Gould, A.; Frieman, J.A.; Freese, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1029-1045(15 Feb 1989).

Weakly interacting massive particles (WIMP's) with masses approx. >1 GeV are candidates for the dark matter in galactic halos. We discuss the distribution and detectability of coherently interacting particles (such as massive Dirac or scalar neutrinos, solar cosmions, and some Majorana fermions) that have been captured into orbits within the Earth. Coherent WIMP's in the mass range from 8 to 21 GeV in Earth orbits would give rise to count rates ~(1—1000/kg eV day) in proposed cryogenic detectors operating at thresholds ~1 eV. Over this mass and energy range, these rates are several orders of magnitude larger than those for direct detection of the corresponding particles coming from the halo. Since they orbit through the Earth's core, these Earth-bound WIMP's can be used to probe the temperature structure of the Earth's interior. The temperature of the Earth's inner core can be determined to within 300 K, compared with the present 1000—2000 K uncertainty.

16371 **New p-adic strings from old dual models.** Frampton, P.H.; Okada, Y.; Ubriaco, M.R. (Institute of Field Physics, Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27599-3255). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1152-1157(15 Feb 1989).

In the simplest bosonic p-adic string, a central role is played by an S_3 symmetry in the four-particle amplitude. Using an S_3 analysis of four-point dual amplitudes, we exhibit a general class of p-adic string amplitudes. All are shown to satisfy a factorization (adelic) property for the infinite product over p-adic amplitudes. Explicit examples are worked through for a p-adic string with spin-0 and spin-2 poles and no tachyon.

16372 **Evaporation of strange matter (and similar condensed phases) at high temperatures.** Alcock, C.; Olinto, A. (Lawrence Livermore National Laboratory, Institute of Geophysics Planetary Physics, Livermore, California 94550). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1233-1234(15 Feb 1989).

Strange matter is a form of quark matter that has been conjectured to be stable at zero temperature. If heated to a temperature $T \geq 2$ MeV, a strange-matter lump evaporates nucleons from its surface. We show that at higher temperatures ($T \geq 20$ MeV), strange matter boils, with bubbles of hadronic gas forming and growing throughout the interior. Strange matter, or any other phase which resembles strange matter, could not have survived this process in the early Universe.

16373 **One-jet inclusive cross section at order α/sub s/³: Gluons only.** Ellis, S.D.; Kunszt, Z.; Soper, D.E. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review Letters;* **62**: No. 7, 726-729(13 Feb 1989).

The next-to-leading-order jet cross section is calculated for the simplified case in which there are only gluons. The general structure of the differences from the lowest-order cross section are described. The important new effects at this order are the explicit

dependence on the definition of the jet and the reduced dependence on the choice of the renormalization scale μ^2. While only the purely glue results are discussed here, we expect that the dependence on the jet definition and on μ^2 will be quite similar in the complete calculation, which we are now undertaking.

16374 Renormalization of the statistics parameter in three-dimensional electrodynamics. Semenoff, G.W.; Sodano, P.; Wu, Y. (Department of Physics, University of British Columbia, Vancouver, Canada V6T 2A6). *Physical Review Letters;* **62**: No. 7, 715-718(13 Feb 1989).

We argue that the β function for the statistics parameter in (2+1)-dimensional electrodynamics is zero to all orders in perturbation theory beyond one loop. We show that there can be finite radiative corrections from massless charged scalar fields.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 16370, 16398, 16400, 16401, 16402

16375 Model of exotic baryon-number nonconservation at moderate energies. He, X.; Joshi, G.; Ma, E. (School of Physics, University of Melbourne, Parkville, Victoria 3052, Australia). *Physical Review [Section] D: Particles and Fields;* **39**: No. 5, 1454-1457(1 Mar 1989).

We study the consequences of a supersymmetric gauge model based on E_6 particle content previously proposed by one of us which conserves lepton number but not baryon number. Neutral fermions are present in this model which can decay into qqq and q-bar q-bar q-bar. We discuss their properties and show that they do not contribute significantly to the baryon asymmetry of the Universe.

16376 Symmetries of the hubbard model and the θ term in the σ-model. Balachandran, A.P.; Bowick, M.J.; Gupta, K.S.; Srivastava, A.M. (Physics Dept., Syracuse Univ., Syracuse, NY (US));. *Modern Physics Letters B;* **3**: No. 17, 1725-1732(Dec 1988).

Recently, it has been shown that the strong coupling limit of the half-filled Hubbard model has SU(2) gauge invariance. The 2 + 1-dimensional nonlinear σ model with the customary θ term does not have this symmetry--instead it has a U(1) gauge symmetry. A modification of the θ term is suggested so that the model acquires SU(2)--or rather SO(3)--gauge symmetry. The symmetries of this modified model thus resemble more closely those of the strongly coupled half-filled Hubbard model. Gauge invariance of the new model, unlike that of the U(1) model, requires quantization of the angle θ. The allowed θ values are $m\pi/2$ (mod 2π) with m an integer. Hence the allowed soliton spins are $m/4$ ($m\epsilon Z$) while their statistics are governed by their spins in the usual way.

16377 Supersymmetric chiral bosons on group manifolds. Bellucci, S. (INFN-Laboratori Nazionali di Frascati, C.P. 13, 00044 Frascati (IT)); Brooks, R. (ISLAC, Stanford Univ., Stanford, CA (US)); Sonnenschein, J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA (US));. *Modern Physics Letters B;* **3**: No. 16, 1537-1550(Nov 1988).

The authors give the WZW models, for supersymmetric leftons and rightons. Super-Kac-Moody currents and the coupling to non-abelian, gauge superfields are derived. The locally supersymmetric theory is discussed. Due in part to the progress made in the compactification of superstrings, the study of U(1) chiral bosons has blossomed in the past year. Non-abelian chiral bosons have also been studied, although much less so than their abelian limits. Much work has also been done on the supersymmetric extensions of the U(1) theories. Studies of the supersymmetric, non-abelian theory are also present in the literature. In this letter, the authors present some of the results they have obtained for the supersymmetric theories. The authors' non-linear sigma model actions are presented. They also derive the self-duality constraint.

16378 Two-body radiative gluino decays. Ma, E.; Wong, G.G. (Dept. of Physics, Univ. of California, Riverside, CA (US));. *Modern Physics Letters B;* **3**: No. 16, 1561-1568(Nov 1988).

A gluino can decay into a color-singlet neutral fermion chi bar by radiating off a gluon. The authors study this process in a minimal supersymmetric extension of the standard model. A significant branching fraction is possible depending on how much chi bar overlaps with the Higgs fermion which couples to the tau quark and the mass of the tau quark itself.

16379 Geometric hierarchy, global and local SUSY. Raby, S. (Theory Div., T-8, Los Alamos National Lab., Los Alamos, NM (US));. pp v of Supersymmetry and supergravity nonperturbative QCD. Roy, P.; Singh, V. New York, NY; Springer-Verlag New York Inc. (1984). (CONF-8401116—).

From Winter school on supersymmetry and supergravity nonperturbative QCD; Mahabaleshwar, India (5 Jan 1984).

What good is SUSY? The following is a list of problems for which SUSY may provide some answers: (i) It may provide a unified field theory of all forces. Certainly this is the goal for N=8 SUSY. (ii) It may predict three families of quarks and leptons. This possibility has been suggested on several occasions. (iii) It may solve the problem of the cosmological constant. Unfortunately, at the present time there is no real solution in sight. (iv) It can provide an explanation for the small ratio M/sub W//M/sub pl/ $\simeq$ 10/ sup -17/. A verifiable consequence of such an explanation is a SUSY GAP [the mass splitting between fermions and their scalar partners] of order 1 TeV or less. (v) Finally, SUSY may provide some clue to quark and lepton mass matrices and hence, reduce the number of independent parameters, of order 20. This paper includes the following topics: (A) Motivation for GH; (B) Generating the Grand Unification [GUT] Scale; (C) The Effective Low-Energy Theory; (D) Decoupling of SUSY Breaking Effects; (E) The Second Hierarchy Problem; (F) R Invariance and the Peccei-Quinn Symmetry.

6454 Field Theory

REFER ALSO TO CITATION(S) 16326, 16369, 16372, 16375, 16376, 16379

16380 (BiBoS—320/88) Particles and 'bumps' in quantum field configurations. Blanchard, P.; Carlen, E.A.; Dell'Antonio, G.F. (Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik; Princeton Univ., NJ (USA). Dept. of Mathematics; Rome-1 Univ. (Italy). Dipt. di Matematica). (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS); Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik). 1988. 21p. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

We study the extent to which the identification of particles with 'bumps' in quantum field configurations can be made precise. The main difficulty is that typical field configurations are distributions, and not elements of the classical configuration space of the field theory. We show that this can be ascribed to the effects of 'vacuum fluctuations' in a very natural manner, and that these may be 'filtered out', leaving a function in the classical field configuration space. For an n particle state with the n particles well localized and well separated in the Newton-Wigner sense, the filtered field configuration has n bumps, located where the particles are. Our results help illuminate the Born interpretation for the wave function in field theory, and they yield a natural directly field theoretic approach to the notion of localized states.

16381 (BNL—42086) Lattice gauge theory and Monte Carlo methods. Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). Nov 1988. Contract AC02-76CH00016. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005666/JAW.

Lattice gauge theory is now the primary non-perturbative technique for quantum field theory. The lattice represents an ultraviolet cutoff, and renormalization group arguments show how the bare coupling must be varied to obtain the continuum limit. Expansions in the inverse of the coupling constant demonstrate quark confinement in the strong coupling limit. Numerical simulation has become the approach to calculating hadronic properties. The basic algorithms for obtaining appropriately weighted gauge field con-

figurations are discussed. Algorithms for treating fermionic fields, which still require considerably more computer time than needed for purely bosonic simulations, are also discussed. Some particularly promising recent approaches are based on global accept-reject steps and should display a rather favorable dependence of computer time on the system volume. 39 refs.

16382 **(BNL—42129) Simulating the SU(2) sector of the standard model with dynamical fermions.** Lee, I. Hsiu. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-8809247—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005644/JAW.

From Lattice '88: symposium on lattice field theory; Batavia, IL, USA (22 Sep 1988).

The two-generation SU(2) sector of the standard model with zero Yukawa couplings is studied on the lattice. The results from analytic studies and simulations with quenched fermions are reviewed. The methods and results of a Langevin simulation with dynamical fermions are presented. Implications for the strongly coupled standard model are mentioned. 23 refs.

16383 **(CBPF-NF—043/88) Quantum field theory in non-stationary coordinate systems and Green functions.** Svaiter, B.F.; Svaiter, N.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 29p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705406/JAW.

In this paper we studied a neutral massive scalar field in a bi-dimensional Milne space time. The quantization is made on hyperboles which are Lorentz invariant surfaces. The expansion for the field operator was carried on using a complete set of orthonormal modes which have definite positive and negative dilatation frequence. We have calculated the advanced and retarded Green function and proved that the Feynman propagator diverges in the usual sense.

16384 **(DOE/ER/40272—66) Lattice strings.** Thorn, C.B. (Florida Univ., Gainesville (USA). Dept. of Physics). 15 Nov 1988. Contract FG05-86ER40272. 21p. (CONF-8805214—3; UFTP—88-16). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006900/JAW.

From Strings '88: superstring workshop; College Park, MD, USA (24 May 1988).

The possibility of studying non-perturbative effects in string theory using a world sheet lattice is discussed. The light-cone lattice string model of Giles and Thorn is studied numerically to assess the accuracy of "coarse lattice" approximations. For free strings a 5 by 15 lattice seems sufficient to obtain better than 10% accuracy for the bosonic string tachyon mass squared. In addition a crude lattice model simulating string like interactions is studied to find out how easily a coarse lattice calculation can pick out effects such as bound states which would qualitatively alter the spectrum of the free theory. The role of the critical dimension in obtaining a finite continuum limit is discussed. Instead of the "gaussian" lattice model one could use one of the vertex models, whose continuum limit is the same as a gaussian model on a torus of any radius. Indeed, any critical 2 dimensional statistical system will have a stringy continuum limit in the absence of string interactions. 8 refs., 1 fig. , 9 tabs.

16385 **(GSI—88-64(prepr.)) Thermo field dynamics and the generation of bosonic coherent states.** Henning, P.A.; Becker, C.; Lang, A.; Winkler, U. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1988. 7p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

The time-dependent bosonic state of an interacting field theory is constructed explicitly, to lowest order in the interaction, within the framework of the Schwinger-Keldysh formalism. The result is a coherent state, thus justifying the usual semiclassical treatment of the bosons, but also opening a new way for going beyond the mean-field approximation.

16386 **(IAE—4651/1) On soliton interactions of the sine-Gordon equation.** Surkov, E.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705453/JAW.

It is demonstrated that sin-Gordon solitons can be compared with point particles interacted due to short-range energy-dependent forces. In this approach the quasiclassical quantization of breather is made. 5 refs.

16387 **(IFT-P—19/88) Two-body Dirac equation with a scalar linear potential.** Ferreira, P.L. (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705471/JAW.

A semi-relativistic equation which describes the relative motion of a Dirac particle and its antiparticle, interacting through a scalar potential, linearly dependent on the relative distance, is investigated. (M.W.O.).

16388 **(IFVE-OTF—88-86) Hamiltonian dynamics of finite-lacuna configurations of relativistic string.** Berdnikov, E.B.; Pron'ko, G.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705486/JAW.

Submitted to the journal Teor. Mat. Fiz. .

The classical dynamics of a Nambu-Goto string is considered using the auxiliary spectral problem. With the help of Lorentz-invariant spectral data we construct action-angle variables. The simplectic structure for the phase space reduced to finite-lacuna configurations of the string has been found. A geometrical meaning of the topological charge of the string is also discussed. 11 refs.

16389 **(IN2P3—8801) Nonperturbation aspects of QCD. Monte Carlo and optimization.** Brezin, E.; Morel, A.; Marinari, E.; Couchot, F.; Narison, S.; Richard, J.M.; Blaizot, J.P.; Souillard, B. (eds.). (Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France)). 1988. 307p. (In French). (CONF-8609297—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88756678/JAW.

From 18. summer school on particle physics; Gif-sur-Yvette, France (8 Sep 1986).

Phase transitions; lattice QCD; numerical simulation of lattice gauge theories; experimental research on gluonic mesons; QCD-duality sum rules; the bag model, potentials, and hadron spectra; and efficient Lagrangian functions and the Skyrme model are introduced.

16390 **(INIS-BR—1395) Symmetry restoration in the Georgi-Glashow model at finite temperature.** Guerra Junior, J.M. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1985. 175p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88705509/JAW.

Symmetry restoration in the SU(5) model is analysed by means of finite temperature field theory. In our calculations symmetry restoration is due to topological defects which appear thanks to thermodynamical effects. We apply our results in cosmology, in order to explain the primordial inhomogeneity. Our results are compatible with Zeldovich's spectrum.

16391 **(INIS-BR—1401) Classical field configurations in curved spaces.** Mondaini, R.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1984. 167p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88705514/JAW.

We describe a possible formation of non-abelian gange theories in a curved space-time and its main properties. (M.W.O.).

16392 **(ITEP—96(1988)) Anomalies in Witten's NSR superstring field theory.** Aref'eva, I.Ya.; Medvedev, P.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 25p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705554/JAW.

The action of Witten's NSR superstring field theory if shown to depend on the regularization being choosen to define its value on non-smooth states that are generated by supertransformation. The necessity of additional regularization originates from the appearance of products of picture-changing operators in coincident points. Two different regularization are described, one corresponding to Witten's scheme and the other to the scheme based on the notion of truncated fields. 12 refs.

16393 **(LA-UR—88-4045) Simulating QCD with dynamical Wilson and staggered fermions.** Gupta, R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 21p. (CONF-8809247—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005453/JAW.

From Lattice '88: symposium on lattice field theory; Batavia, IL, USA (22 Sep 1988).

The author presents a summary of the work done during the last year by the Los Alamos lattice collaboration to study QCD with the Hybrid Monte Carlo Algorithm. The specific questions addressed are the finite temperature transition for both staggered and Wilson fermions and screening in the heavy q{bar q} potential with Wilson fermions. The author also presents a discussion of the efficiency of the fermion update algorithm. 13 refs., 8 figs.

16394 **(UFPB-DF—02/88) Field theory hamiltonization as a twofold procedure.** Espindola, M.L.; Espindola, O.; Teixeira, N.L. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1988. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705597/JAW.

A field theory hamiltonization procedure valid for both linear (on phi/sub t/) and non-linear Lagrangians is proposed. It is shown that usual hamiltonian formulation is based on an envelope solution of a partial differential equation. The choice of the complete solution of the same equation leads to an alternative hamiltonian description of the same field and is the only open possibility for linear Lagrangian systems.

16395 **Determination of phases of generalized Kobayashi-Maskawa matrix elements from their magnitudes.** Bjorken, J.D. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1396-1397(1 Mar 1989).

For an N-generation Kobayashi-Maskawa mixing matrix having the property that matrix elements decrease rapidly with increasing generation change, we show by construction that knowledge of the moduli of all elements is sufficient, up to a discrete ambiguity, to determine all phase information.

16396 **Perturbative QCD corrections to the ratio R for tau decay.** Braaten, E. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1458-1460(1 Mar 1989).

The perturbative QCD correction to the semihadronic decay rate of a heavy lepton is expressed as an expansion in $\alpha/\text{sub } s/$. In the case of the tau lepton, the ratio of the semihadronic and electronic decay rates is $R = 3[1+\alpha/\text{sub } s//\pi+5.20(\alpha/\text{sub } s//\pi)^2 +104.0(\alpha/\text{sub } s//\pi)^3]$. The use of R to give a precise determination of $\alpha/\text{sub } s/$ is advocated.

16397 **Model for an attractive feeble force.** Halprin, A.; Barnhill M.V. III; Barr, S. (Department of Physics and Astronomy, University of Delaware, Newark, Delaware 19716). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1467-1470(1 Mar 1989).

We present an economical and technically natural model for a scalar feeble force. The scalar couples to ordinary quarks and leptons only through mixing with the ordinary Higgs boson of the standard model. There is therefore a definite prediction for the composition dependence of the force, as well as the qualitative prediction that the physical Higgs boson of the standard model should be light.

16398 **Three generation superstring models with maximal discrete symmetries.** Lazarides, G.; Shafi, Q. (Physics Division, School of Technology, University of Thessaloniki, Thessaloniki, Greece). *Journal of Mathematical Physics (New York);* **30**: No. 3, 711-718(Mar 1989).

Discrete symmetries typically arise when the ten-dimensional heterotic $E_8 \times E_8$ superstring theory is compactified on Calabi—Yau (CY) manifolds and they are expected to play an essential role in phenomenological applications. Yau has shown how a CY manifold that leads to three generation models can be constructed. The discrete symmetries associated with several of these models are found. In particular, the models that have the largest (maximal) discrete symmetries are identified.

16399 **Improved integral representation for the finite-temperature propagator in string theory.** Leblanc, Y. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1139-1151(15 Feb 1989).

We present an improved integral representation for the space-time propagator in finite-temperature string theory. The new representation allows us to obtain closed-form expressions for finite-temperature n-point functions which are suitable for regularization and also for discussion of the problem of gauge invariance. An algorithm to obtain Tnot $=0$ expressions from the zero-temperature theory is developed and explicit computations of one-loop self-energy diagrams are carried out. In particular we show the vanishing of the massless-vector-boson self-energy in the limit of zero momentum, as required by gauge invariance. Finally, we point out the possible relevance of the above representation and algorithm to the calculation of the free energy at higher genus.

16400 **BRST quantization of the CP^1 model with Chern-Simons term in $2+1$ dimensions.** Voruganti, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1179-1185(15 Feb 1989).

Field theory on CP^1 with a Chern-Simons term is analyzed classically and then quantized. The constrained system is disentangled using the elegant Becchi-Rouet-Stora-Tyutin (BRST) method. The quantum Hamiltonian, the BRST charge, and the anti-BRST charge are derived. Application to a recently proposed model with principal chiral fields is elaborated.

16401 **Radiative symmetry breaking in $(2+1)$-dimensional space.** Babu, K.S.; Panigrahi, P.; Ramaswamy, S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1190-1195(15 Feb 1989).

We present a systematic study of the one-loop effective potential in U(1)-invariant theories involving scalars, fermions, and gauge fields in $(2+1)$-dimensional space. We first consider a scale-invariant theory and find that no radiative symmetry breaking is induced. A similar result is obtained for the case of ordinary QED and Chern-Simons QED. However, radiative symmetry breaking always occurs when the scalar is also coupled to a charged fermion. We then verify that symmetry is restored at high temperature.

16402 **Confining phase transition as monopole condensation.** Rosenzweig, C. (Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1221-1224(15 Feb 1989).

Charges are confined in a monopole condensate. We investigate a model based on an SU(2) Higgs model in which the preferred ground state has a nonzero value of the monopole field. For temperatures when $\alpha(T) \cong 1$ the model suggests a first-order confining-deconfining phase transition. The inclusion of massive fermions weakens this phase transition and it disappears completely when the fermion mass is comparable to the confining scale.

16403 **Nonexistence of spherically symmetric monopole solutions in the three-generation superstring model.** Lazarides, G.; Shafi, Q.; Tomaras, T.N. (Physics Division, School of Technology, University of Thessaloniki, Thessaloniki, Greece). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1239-1241(15 Feb 1989).

The three-generation superstring model based on Calabi-Yau compactification of the heterotic $E_8 \times E_8$ superstring theory predicts the existence of topologically stable magnetic monopoles. We show that the model does not admit spherically symmetric magnetic-monopole solutions. The regular finite-energy solutions in this case must then be nonspherically symmetric.

16404 **Metropolis and Langevin time.** Baillie, C.F.; Johnston, D.A. (California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1246-1248(15 Feb 1989).

We show that a linear relation between Metropolis and Langevin time in computer simulations observed by Meakin et al. for spinodal decomposition is also true for lattice gauge theories.

16405 **Gluonia.** Heusch, C.A. (Institute for Particle Physics, Univ. of California, Santa Cruz, CA (US));. pp v of Proceedings of the Yukon Advanced Study Institute on the quark structure of matter. Isgur, N.; Karl, G.; O'Donnell, P.J. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8408129—).

From Conference on the quark structure of matter; Scarborough, Ontario, Canada (11 Aug 1984).

The postulated existence of hadrons with no quark content, implied by the non-Abelian nature of quantum chromodynamics, has been the object of much experimental activity. Recent data from radiative psi decay permit a confrontation of available evidence with the most simple-minded criteria for their appearance. In the absence of compelling positive evidence the authors give a rating of the relative merits of several possible candidates.

65 PHYSICS II

REFER ALSO TO CITATION(S) 16176

16406 **(INIS-SU—69) Experimental and theoretical physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1988. 50p. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizika.; No. 6.

Selected papers have been processed separately for the Energy Data Base.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 16525

16407 **(BNL-NCS—41300) NRDSRS users manual.** McLane, V. (National Nuclear Data Center, Upton, NY (USA)). Nov 1988. Contract AC02-76CH00016. 67p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007010/JAW.

The Nuclear Reaction Data Storage and Retrieval System at the National Nuclear Data Center (NNDC) consists of data for, and bibliographic references to, nuclear reaction data induced by neutrons, charged particles and photons. The data are obtained through compilation efforts at the NNDC and through an exchange agreement with data centers and institutions throughout the world. Retrievals may be made from the system for either bibliographic references to the data or for the data itself. The remainder of this chapter outlines the general retrieval criteria and output formats presently available. Sample retrieval output is found in Appendix B.

16408 **(CONF-8809203—3) Results from WA80 on transverse energy production, fluctuations in multiparticle production, and γ/π^0 ratios.** Young, G.R.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Clewing, G.; Dragon, L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006412/JAW.

From Quark Matter '88: 7th international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, USA (26 Sep 1988).

Results are presented concerning transverse energy production from the WA80 run of 1987 using beams of E/A = 200 GeV ^{32}S produced by the CERN SPS. Comparisons are made to the earlier results obtained with E/A = 60 and 200 GeV ^{16}O. The results of an analysis of fluctuations in the charged-particle pseudorapidity densities for the ^{16}O data are presented next. These analyses were carried out following a method suggested by Bialas and Peschanski. This reveals fluctuations down to pseudorapidity scales of $\delta\{eta\} = 0.1$. Finally, a preliminary value is presented for the excess of observed photons over known sources in reactions of E/A = 200 GeV ^{16}O + Au. These measurements span the pseudorapidity interval $1.5 < \{eta\} < 2.1$ and transverse momentum range p/sub T/ = 0.4--2.4 GeV/c. This excess is observed for central O + Au collisions but not for peripheral O + Au collisions. 16 refs., 7 figs.

16409 **(DOE/ER—0404) Summaries of FY 1988 research in nuclear physics.** (USDOE Office of Energy Research, Washington, DC. Nuclear Physics Div.). Feb 1989. 229p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007097/JAW.

This report summarizes the research projects supported by the Division of Nuclear Physics in the Office of High Energy and Nuclear Physics, during FY 1986. This Division is a component of the Office of Energy Research, the basic research branch of the US Department of Energy, and provides about 80% of the funding for nuclear physics research in the United States. The objective of the Nuclear Physics program is to understand the interactions, properties, and structures of nuclei and nuclear matter and to understand the fundamental forces of nature as manifested in atomic nuclei. These summaries are intended to provide a convenient guide for those interested in the research supported by the Division of Nuclear Physics. The nuclear physics research summaries in this document were initially prepared by the investigators, then reviewed and edited by DOE staff. They describe the general character and goals of the research programs, current research efforts, especially significant recent results, and plans for the near future. The research summaries are organized into two groups: research programs at national laboratories and those at universities, with the material arranged alphabetically by institution. The names of all Ph.D.-level personnel who are primarily associated with the work are included. The FY 1988 funding levels are also provided. Included for the first time are activities of the nuclear data program, which was incorporated within nuclear physics in FY 1987. We remind the readers that this compilation is just an overview of the Nuclear Physics program. Primary publications should be used for reference to the work and for a more complete and accurate understanding.

16410 **(DOE/ER/40361—2) Nuclear spectroscopic studies: Progress report.** Bingham, C.R.; Guidry, M.W.; Riedinger, L.L.; Sorensen, S.P. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 31 Jan 1989. Contract FG05-87ER40361. 112p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006906/JAW.

The Nuclear Physics Group at the University of Tennessee, Knoxville (UTK) is involved in several aspects of heavy-ion physics including both nuclear structure and reaction mechanisms. While our main emphasis is on experimental problems involving heavy-ion accelerators, we have maintained a strong collaboration with several theorists in order to best pursue the physics of our measurements. During the last year we have led experiments at the Holifield Heavy Ion Research Facility (HHIRF) and the Niels Bohr Institute Tandem Accelerator. Also, we are active in a collaboration (WA80) to study ultra-relativistic heavy ion physics utilizing the SPS accelerator at CERN in Geneva, Switzerland. Our

experimental work is four broad areas: (1) the structure of nuclei at high angular momentum, (2) heavy-ion induced transfer reactions, (3) the structure of nuclei far from stability, and (4) ultra-relativistic heavy-ion physics. These results will be described in this document. Areas (1), (3), and (4) concentrate on the structure of nuclear matter in extreme conditions of rotational motion, imbalance of neutrons and protons, or very high temperature and density. Area (2) pursues the transfer of nucleons to states with high angular momentum, both to learn about their structure and to understand the transfer of particles, energy, and angular momentum in collisions between heavy ions. An important component of our program is the strong emphasis on the theoretical aspects of nuclear structure and reactions.

16411 **(DOE/ER/40408—105) Deexcitation processes in nuclear reactions: Progress report.** Porile, N.T. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). Sep 1988. Contract FG02-88ER40408. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006383/JAW.

This paper discusses the following topics: search for QGP in {bar p}-p collisions at the Tevatron; and momentum transfer and mass field distribution in intermediate energy heavy ion reactions. 6 figs. (LSP)

16412 **(INDC(NDS)—209/GZ) Status on the compilation of nuclear data for medical radioisotopes produced by accelerators.** Gandarias-Cruz, D.; Okamoto, K. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Oct 1988. 123p. NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705495/JAW.

The status of data on excitation functions and thick target yields for medical radioisotopes produced by accelerators is summarized. Most of the information was extracted from the compiled data in EXFOR (EXCHANGE FORMAT) which is a common format used by the co-operating nuclear data centres in the world. The nuclear decay mode, half-life, production method, Q-value, maximum cross-section value and the energy at this maximum, are tabulated. For some commonly used reactions, the available excitation functions are plotted in graph. (author). 353 refs.

16413 (INIS-SU—68, pp 539) **Tables of standard reference data on decay and radionuclide radiation, used for graduation of SCD spectrometers in the range of 5-140 keV photon radiation.** Bakhshi-zade, V.A.; Garzanov, I.Ya.; Labushkin, V.G.; Nedovesov, V.G.; Chechev, V.P.; Checheva, E.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16414 (INIS-SU—68, pp 544-545) **Production cross sections of some long-lived nuclides in the /sup 197/Au(p,x) reaction at E/sub p/=1 GeV.** Aleksandrov, Yu.V.; Bogdanov, A.I.; Vasil'ev, S.K.; Ivanov, R.B.; Kocherov, N.P.; Mikhajlova, M.A.; Prikhodtseva, V.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16415 (INIS-SU—68, pp 586) **Yields of prompt gamma radiation under irradiation of thick targets by protons.** Korda, L.P.; Nemashkalo, B.A.; Khomyakov, G.K.; Kachan, A.S.; Vodin, A.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16416 **(LBL—26277) Chemistry of heavy ion reactions.** Hoffman, D.C. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 48p. (CONF-8807133—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006668/JAW.

From 2. international conference on nuclear and radiochemistry; Brighton, UK (11 Jul 1988).

The use of heavy ions to induce nuclear reactions was reported as early as 1950. Since that time it has been one of the most active areas of nuclear research. Intense beams of ions as heavy as uranium with energies high enough to overcome the Coulomb barriers of even the heaviest elements are available. The wide variety of possible reactions gives rise to a multitude of products which have been studied by many ingenious chemical and physical techniques. Chemical techniques have been of special value for the separation and unequivocal identification of low yield species from the plethora of other nuclides present. Heavy ion reactions have been essential for the production of the trans-Md elements and a host of new isotopes. The systematics of compound nucleus reactions, transfer reactions, and deeply inelastic reactions have been elucidated using chemical techniques. A review of the variety of chemical procedures and techniques which have been developed for the study of heavy ion reactions and their products is given. Determination of the chemical properties of the trans-Md elements, which are very short-lived and can only be produced an "atom-at-a-time" via heavy ion reactions, is discussed. 53 refs., 19 figs.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 15787

16417 **(CONF-881151—51) UNISOR Nuclear Orientation Facility.** Girit, I.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400;AS05-76ER05034;AC05-76OR00033. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006132/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The combination of an on-line isotope separator and a dilution refrigerator has increased the applicability of the nuclear orientation technique to a wide range of nuclei, especially those very far from stability. The UNISOR Nuclear Orientation Facility (UNISOR/NOF) is among the two (the other being NICOLE at CERN) that have recently become operational. The following is an overall view of the UNISOR system and recent results. 24 refs., 3 figs.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

16418 **(DOE/ER/40362—2) Pion- and proton-nucleus interactions at intermediate energy: Progress report, 1 June 1988--31 May 1989.** Dehnard, D. (Minnesota Univ., Minneapolis (USA)). Jan 1989. Contract FG02-87ER40362. 51p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007116/JAW.

Data were taken for elastic scattering of π^+ and π/sup {minus}/ at far forward angles as part of our continuing study of this system near [3,3] resonance energies. The work on data reduction of the ^{4}He (π/sup +-/,π/sup +-/,p) and ^{12}C(π/sup +-/,π/sup +-/,p) reactions was completed. Comparisons with DWIA predictions for quasifree knockout yield evidence for an interference of two processes: quasifree knockout, and formation and decay of states of good isospin in the giant resonance region. The replay and analysis of our ^{4}He(p,p') data at 500 and 800 MeV were continued and gave new information on the monopole strength in ^{4}He. Preparations were made for the pion scattering experiments on polarized ^{13}C which is scheduled for the summer of 1989.

16419 (FRNC-TH—3301) Collisional ionization of excited helium atoms He(n/sup 1P/) in intermediate Rydberg states by polar or high electron affinity molecules. Ronge, C. (Paris-11 Univ., 91 - Orsay (France)). 1987. 250p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756675/JAW.

Collisional ionization of helium atoms selectively excited in intermediate Rydberg states is studied in a crossed beam experimental device. An important H/sup +/ ion signal is observed with two types of target: polar molecules and molecules with a high degree of electronic affinity. For each process, the variation of the collision as a function kinetic energy, and the absolute value of the total ionization cross section in the thermal domain (20-500MeV) are measured. The results cannot be interpreted within the framework of the free electron model. This model reduces the interactions in the system concerned to simply the interaction of the Rydberg electron with the molecule, which is treated by dipolar Born approximation. Calculations based on a less restrictive approach to the interactions confirm the importance of rotational transitions at several quanta previously neglected.

16420 (Juel-Spez—461) Structure of /sup 4/He and /sup 4/Li and decay of the giant resonances in /sup 238/U. Brinkmoeller, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bonn Univ. (Germany, F.R.)). Jul 1988. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756814/JAW.

With the p(α, /sup 3/He p)n reaction it has been succeeded for the first time to produce /sup 4/Li really. The total cross section of this reaction could be described consistently regarding the sequential decay of states in the α particle, in /sup 4/Li, and the p-n final-state interaction for all measured spectra. For the excitation of the low-lying L=1 1/sup -/ and 2/sup -/ states in the α(p, p')α and the α(p, n)/sup 4/Li reaction cross sections were extracted. These values are consistent with predictions from DWBA calculations for a one-particle transition from the s into the p shell. The found values for the resonance energies and the widths for the 2/sup -/ ground state and the first excited 1/sup -/ state of /sup 4/Li amount to E/sub r/ = 3.4 MeV, γ/sup 2/ = 1.0 MeV respectively E/sub r/ = 5.7 MeV, γ/sup 2/=1.5 MeV. With the coincident measurement of the /sup 238/U(α, α'f) reaction the decay of the giant quadrupole resonance was detected in the fission channel. (orig./HSI).

16421 Evidence for M1 strength in the ^{3}H(p-arrow-right,γ)^{4}He reaction. Wagenaar, D.J.; Roberson, N.R.; Weller, H.R.; Tilley, D.R. (Duke University and Triangle Universities Nuclear Laboratory, Duke Station, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 352-358(Feb 1989).

Angular distributions of cross sections and analyzing powers were measured for the ^{3}H(p-arrow-right,γ)^{4}He reaction at incident proton energies of 2.0, 5.0, and 9.0 MeV. The 90° analyzing power was measured at 11 energies between 0.8 and 9.0 MeV. A transition matrix element analysis indicated that the inclusion of M1 strength gave better fits and eliminated the anomalously large $^3D_2$ (E2) strength reported in earlier work. An E1-plus-E2 direct capture calculation was performed. It is shown that this calculation can be brought into agreement with the data if an M1 strength comparable to that found in the T-matrix element analysis (0.5—1.0% of the total capture cross section) is added.

16422 Survey of experimental results in muon-catalyzed fusion. Jones, S.E. (Department of Physics and Astronomy, Brigham Young University). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 2-16(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

Over the past decade of research muon-catalyzed fusion yields have significantly exceeded expectations. A simple equation for fusion yield 1/Y = λ/sub o//λ/sub c/ + W, where Y is the fusion yield, λ/sub o/ is the muon decay rate, λ/sub c/ is the muon-catalysis cycling rate, and W is the probability of muon loss per catalysis cycle, will guide this discussion. It indicates that to increase fusion yield the catalysis rate needs to be maximized and the muon losses must be at a minimum. We will review what has been learned about these parameters, then examine the current fusion yields vis-a-vis energy applications for muon- catalyzed fusion. (AIP)

6513 Nuclear Properties And Reactions, A=6-19, Experimental

16423 (DOE/ER/40147—7) The energy dependence of momentum widths in the projectile fragmentation of ^{16}O. Guzik, T.G.; Mitchell, J.W.; Wefel, J.P.; Crawford, H.J.; Engelage, J.; Lindstrom, P.J.; Schimmerling, W. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy; Lawrence Berkeley Lab., CA (USA)). 1986. Contract FG05-84ER40147;AC03-76SF00098. 24p. (CONF-8606423—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005329/JAW.

From 3. international conference on nucleus-nucleus collisions; St. Malo, France (6 Jun 1986).

Projectile-like fragments from nuclear collisions above {approximately}20 MeV/u show features similar to those observed in high energy projectile fragmentation, but the description of the physical process is different. The 80-400 MeV/u region contains information on the transitional behavior and may reveal more detail on the fragmentation mechanism, particularly if a single projectile can be studied as a function of energy. Here we present data from 225 MeV/u ^{16}O interacting in a C target and compare the results to date at other energies. The widths of the momentum distributions show an energy dependence which may indicate a more complex production process. 5 refs., 2 figs.

16424 (DOE/ER/40354—2) (p,p') studies of spin excitations in nuclei and of J = 4 nuclear states: Technical progress report. Baker, T. (Georgia Univ., Athens (USA). Research Foundation). Jan 1989. Contract FG09-87ER40354. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006644/JAW.

During 1988 three experiments were performed. These were: ^{1}H, ^{12}C({rvec n},p), E/sub n/ = 860 MeV, at SATURNE, ^{40}Ca({rvec p},{rvec p}'), E/sub p/ = 581 MeV, at LAMPF, and ^{208}Pb({rvec p},{rvec p}'), E/sub p/ = 200 MeV at TRIUMF. The purpose of the (n,p) experiment, performed in June and July, was to attempt to corroborate the previously observed shifts in the (^{3}He,t) quasielastic and Δ peaks. The data are being analyzed, and since there was virtually no on-line readout during this experiment, the results are as yet unknown. 4 refs., 4 figs.

16425 (KFK—4480) Inclusive measurements of the break-up of 156 MeV /sup 6/Li-ions at extreme forward angles and the quasi free break-up model. Jellito, H.; Buschmann, J.; Gils, H.J.; Heide, N.; Kiener, J.; Rebel, H.; Zagromski, S.; Corcalciuc, V.; Samanta, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Institutul Central de Fizica, Bucharest (Romania); Saha Inst. of Nuclear Physics, Calcutta (India)). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Institutul Central de Fizica, Bucharest (Romania); Saha Inst. of Nuclear Physics, Calcutta (India)). Nov 1988. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756816/JAW.

Inclusive alpha particle and deuteron spectra from collisions of 156 MeV /sup 6/Li-ions with /sup 12/C and /sup 208/Pb were measured at extreme forward emission angles including zero degree. The measurements were performed with the Karlsruhe magnetic spectrograph 'Little John' and required an efficient reduction of the background from small-angle scattering. The observed double differential cross sections and angular distributions have been analysed on the basis of Serber's spectator break-up model. When going to angles smaller than grazing, where Coulomb effects are expected to the dominating, transitional features may appear. Corresponding effects probably associated with Coulomb break-up are observed with the /sup 208/Pb-target and require a slight extension of the Serber approach. In the case of the /sup 12/C-target the break-up cross sections in forward direction seem to reflect the shape of the internal momentum distribution of the alpha particle

and deuteron cluster in the /sup 6/Li-projectile and are in agreement with a 2S-type wave function. However, at larger angles the shape appears to be distorted, possibly by final state interactions.

16426 **Multinucleon knockout in electron scattering.** Takaki, T. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 359-383(Feb 1989).

The exclusive (e,e'p) reaction and the inclusive (p,p') reaction for /sup 12/C at intermediate energy are studied in order to understand the reaction mechanism leading to multinucleon knockout in electron scattering. We focus on the effect of the final-state interaction in the missing-energy spectrum measured (under parallel kinematics) in a coincidence (e,e'p) experiment in the dip region, where the many-body process is the dominant channel. To disentangle complex many-body processes and understand the final-state interaction quantitatively, we first study the inclusive (p,p') reaction at the corresponding proton energy, which represents the final-state interaction in the on-shell limit. We show that the single scattering process, which means that the incident proton interacts inelastically with the target nucleon only once before coming out, is dominant at small proton scattering angles and can be treated within the framework of distorted-wave impulse approximation by using the effective nucleon-nucleon (NN) interaction. This prescription is able to be applied to the (e,e'p) reaction, since the forward proton scattering in the final state is important under parallel kinematics. Based on the knowledge obtained from the study of the (p,p') reaction, we examine the two-body type of final-state interaction in electron scattering within the above approach. We indicate limitations of the two-body process as a mechanism for understanding the (e,e'p) reaction.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

16427 **(CONF-8808116—2) Fusion-fission in light nuclear systems.** Sanders, S.J. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005878/JAW.

From Sapporo international symposium: developments of nuclear cluster dynamics; Sapporo, Japan (1 Aug 1988).

The fission process, which has been largely ignored for reactions involving light nuclear systems, will be shown to play a significant role in the $^{32}S + {}^{24}Mg$ reaction at energies greater than about 1 1/2 times the Coulomb barrier energy. The magnitude of the fusion-fission cross section ant its fragment mass dependence are found to be consistent with newer estimates of the fission barriers in lighter systems. The presence of the fission mechanism has significance for understanding the limitation to fusion at higher energies and has implications for comparisons of model calculations of evaporation-residue and associated light-particle yields with experiment. 17 refs., 8 figs.

16428 (INIS-SU—68, pp 531) **Observation of γ-lines Doppler shift in /sup 24/Na radiative decay.** Kupryashkin, V.T.; Mitrokhovich, N.F.; Stril'chuk, N.V.; Feoktistov, A.I.; Shapovalova, I.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16429 (INIS-SU—68, pp 589) **Proton elastic scattering on /sup 36/S nuclei.** Vodin, A.N.; Khomyakov, G.K.; Nemashkalo, B.A.; Korda, L.P.; Babichev, E.O. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16430 (INIS-SU—68, pp 592) **Gamma decay of f/sub 7/2/-analog resonance in /sup 37/Cl.** Vodin, A.N.; Korda, L.P.; Nemashkalo, B.A.; Khomyakov, G.K. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

6515 Nuclear Properties And Reactions, A=39-58, Experimental

16431 **Collective model distorted-wave Born approximation analysis of 500-MeV proton scattering from /sup 40/Ca.** Lisantti, J.; Horen, D.J.; Bertrand, F.E.; Auble, R.L.; Burks, B.L.; Gross, E.E.; Sayer, R.O.; McDaniels, D.K.; Jones, K.W.; McClelland, J.B.; and others. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 568-579(Feb 1989).

A vibrational collective model has been used to analyze 15 bound states in /sup 40/Ca excited by inelastic scattering of 500 MeV polarized protons. It is shown that for those states which have surface peaked charge transition densities the collective model describes the shape and magnitude of the angular distributions quite well. The hadronic deformation lengths extracted are shown to be constant over the incident proton energy range of 25—800 MeV with the exception of data at 185 MeV. The average values for the hadronic deformation lengths are used to calculate the ratio of the neutron to proton multipole matrix elements for five states. Elastic scattering and the 3_1^-, 2_1^+, and 5_1^- transitions have also been studied using the relativistic collective model.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

16432 (IA—1440, pp 158) **Influence of atomic binding on nuclear-resonance photon scattering from the 7362 keV level in /sup 68/Zn.** Moreh, R.; Shahal, O. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16433 **(PNL-SA—16639) Status of $\beta\beta$-decay experiments in the year of the Reines Fest.** Avignone, F.T. III; Brodzinski, R.L.; Reeves, J.H.; Miley, H.S. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 14p. (CONF-8806204—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006939/JAW.

From 13. international conference on neutrino physics and astrophysics; Boston, MA, USA (5 Jun 1988).

A brief update is given on a number of Oν $\beta\beta$-decay experiments. Progress is reported in background reduction, limits are given on the various modes of decay, and projections of potential sensitivity are made in some cases. A new result from the ITEP-Yerevan experiment yields a half-life T/sup 2ν/(^{76}Ge) = (0.75/sub {minus}0.2//sup +0.5/) {times} 10^{21} y. A critique of this result is given. New PNL-USC experiments utilizing {approximately}200-cm^3 detectors fabricated from recently deep-mined Ge to decrease background cosmogenic radioactivity are in progress. 16 refs., 2 figs., 1 tab.

16434 **Two-neutron emission from electromagnetic dissociation of /sup 59/Co and /sup 197/Au targets by relativistic heavy ions.** Hill, J.C.; Wohn, F.K.; Winger, J.A.; Khayat, M.; Mercier, M.T.; Smith, A.R. (Ames Laboratory and Iowa State University, Ames, Iowa 50011). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 524-529(Feb 1989).

Electromagnetic dissociation of /sup 59/Co and /sup 197/Au target nuclei and their subsequent deexcitation by two-neutron emission was observed. Beams of relativistic /sup 12/C, /sup 20/Ne, /sup 40/Ar, /sup 56/Fe, and /sup 139/La ions were used. The measured electromagnetic dissociation cross sections become large for high-Z targets and projectiles, reaching 335 mb for the /sup

197/Au(/sup 139/La,X)/sup 195/Au reaction with 1.26 GeV/nucleon /sup 139/La projectiles. The experimental cross sections in excess of the estimated nuclear contributions are in reasonable agreement with a calculation of the electromagnetic dissociation contribution using the Weizsaecker-Williams method for estimating the virtual photon spectrum.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

16435 (IA—1440, pp 154-155) **Beta-decay of /sup 133/Nd.** Rapaport, M.S.; Liang, C.F.; Paris, P. (Israel Atomic Energy Commission, Tel Aviv; Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16436 (INIS-SU—68, pp 553) **Determination of lanthanum K-fluorescence yield and probabilities of K-capture in /sup 139/Ce decay.** Konstantinov, A.A.; Sazonova, T.E.; Sehpman, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16437 **(Juel—2208) Nuclear-shape change at high angular momenta: Superdeformation in /sup 146/Gd and shape coexistence in /sup 186/Pt.** Hebbinghaus, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Jun 1988. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756810/JAW.

For the study of the superdeformation the nucleus /sup 146/Gd was produced in the /sup 110/Pd(/sup 40/Ar, 4r) and /sup 102/Ru(/sup 48/Ca, 4n) compound-nucleus reactions. By means of the Doppler-shift method the effective lifetimes within the superdeformed bands and by this the quadrupole moment of the superdeformed nucleus could be determined to Q/sub 0/ = 11(+14-4) eb. For the study of shape coexistence the nucleus /sup 186/Pt was measured. This nucleus was produced in the /sup 188/Os (α, 6n) reaction. In this report 13 rotational bands were established in /sup 186/Pt, because of the properties of these shape coexistence at spins $\geqq$ 12 could be detected. The yrast band shows a (πh/sub 9/2/) backbending. The nucleus has in this configuration prolate shape. Furthermore a decoupled negative-parity band with a (πi/sub 13/2/)(πh/sub 9/2/) configuration and a strongly coupled negative-parity band with a 11/2[615] x 9/2[505]sub(Ω=10) Nilsson-model configuration were found in which the nucleus has also a prolate shape. However furthermore a decoupled positive-parity band with a band head at spin 12 was established. This band has a (νi/sub 13/2/)/sup 2/ configuration at oblate nuclear shape. Furthermore a half decoupled band consisting of two signature branchings on the base of an I/sup π/ = 5/sup -/ state was observed. The configuration of this band consists of an i/sub 13/2/-neutron and a neutron of the 5. Nilsson main shell. (orig./HSI).

16438 **(LBL—26303) An experimental investigation of double beta decay of ^{100}Mo.** Dougherty, B.L. (Lawrence Berkeley Lab., CA (USA)). 17 Nov 1988. Contract AC03-76SF00098;AC02-78ER04831;AS04-76ER03347. 124p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006832/JAW.

New limits on half-lives for several double beta decay modes of ^{100}Mo were obtained with a novel experimental system which included thin source films interleaved with a coaxial array of windowless silicon detectors. Segmentation and timing information allowed backgrounds originating in the films to be studied in some detail. Dummy films containing ^{96}Mo were used to assess remaining backgrounds. With 0.1 mole years of ^{100}Mo data collected, the lower half-life limits at 90% confidence were 2.7 {times} 10^{18} years for decay via the two-neutrino mode, 5.2 {times}10^{19} years for decay with the emission of a Majoron, and 1.6 {times} 10^{20} years and 2.2 {times} 10^{21} years for neutrinoless $0^+ \rightarrow 2^+$ and $0^+ \rightarrow 0^+$ transitions, respectively. 50 refs., 38 figs., 11 tabs.

16439 **Optical model description of the neutron interaction with /sup 116/Sn and /sup 120/Sn over a wide energy range.** Guss, P.P.; Byrd, R.C.; Howell, C.R.; Pedroni, R.S.; Tungate, G.; Walter, R.L.; Delaroche, J.P. (Department of Physics, Duke University, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 405-414(Feb 1989).

Differential cross sections for neutron elastic scattering and inelastic scattering to the first 2^+ and 3^- excited states have been measured at 10, 14, and 17 MeV for /sup 120/Sn and at 10 and 14 MeV for /sup 116/Sn. Analyzing powers have also been measured at 10 and 14 MeV for elastic scattering from both isotopes and at 10 MeV for inelastic scattering from /sup 120/Sn. These data have been analyzed in the framework of the coupled-channels formalism for vibrational nuclei. Previously reported neutron scattering measurements performed below 25 MeV, along with total cross-section measurements from 10 keV to 100 MeV, and s- and p-wave strength functions were also considered in the analysis in order to place additional constraints on the optical potential parameters. Neutron scattering deformations have been deduced for the quadrupole and octupole vibrations. These deformations have been compared with those derived from earlier (n,n') and (p,p') scattering measurements which were reanalyzed in the present work.

16440 **Preequilibrium neutron emission in the reactions /sup 90/Zr, /sup 208/Pb(p,xn) with 80 MeV projectiles.** Trabandt, M.; Scobel, W.; Blann, M.; Pohl, B.A.; Byrd, R.C.; Foster, C.C.; Bonetti, R. (Institut fuer Experimentalphysik, Universitaet Hamburg, Hamburg, Federal Republic of Germany). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 452-459(Feb 1989).

The reactions /sup 90/Zr, /sup 208/Pb(p,xn) have been measured with 80.5 MeV protons in the neutron continuum E/sub n/>20 MeV and the angular range $0^0 \leqq \theta \leqq 145^0$. Whereas the angle-integrated spectrum can be explained by semiclassical preequilibrium models, this nucleon-nucleon scattering approach fails at far backward angles. In contrast, the quantum statistical multistep calculations give good agreement. They are indicative of a decrease of the effective nucleon-nucleon interaction with increasing nucleon energy.

16441 **Particle-particle coincidence measurements for /sup 1,2,3/H and ^{4}He in the reaction 480 MeV /sup 56/Fe+/sup nat/Ag.** Peaslee, G.F.; Ajitanand, N.N.; Alexander, J.M.; Lacey, R.; Vaz, L.C.; Kaplan, M.; Kildir, M.; Moses, D.J.; Logan, D.; Zisman, M.S.; and others. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 488-496(Feb 1989).

Particle-particle coincidence measurements have been made between light charged particles (/sup 1,2,3/H and ^{4}He) produced in the reaction (8.5 MeV/nucleon) /sup 56/Fe+/sup nat/Ag. This coincidence requirement emphasizes central collisions leading to evaporation residues. Average multiplicities are found to be approximately three alphas and approximately four protons per evaporation residue; these values imply that approximately (1/2 the initial excitation energy of about 211 MeV is evacuated from the evaporation residues by these particles. This fractional energy evacuation by charged particles is considerably larger than that found for the similar reaction (8.5 MeV/nucleon) /sup 40/Ar+/sup nat/Ag. In both reactions the effective emission barriers for ^{1}H and ^{4}He (as deduced from the energy spectra) are found to be significantly lower than corresponding empirical fusion barriers between cold nuclei. This is particularly surprising for emitter nuclei that survive fission.

16442 **Temperatures and excitation energies of hot nuclei in the reactions of /sup 32/S+Ag and /sup 16/O+Ag at 30 MeV/nucleon.** Wada, R.; Fabris, D.; Hagel, K.; Nebbia, G.; Lou, Y.; Gonin, M.; Natowitz, J.B.; Billerey, R.; Cheynis, B.; Demeyer, A.; and others. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 497-515(Feb 1989).

For the reactions of 30 MeV/nucleon /sup 16/O and /sup 32/S with Ag, singles and coincidence measurements have been made for heavy residues, fragments (3≦z≦14), and light charged particles (z≦2). Mass-velocity correlations for the residues and fragment-residue coincidences indicate that increasing residue velocities do correspond to increasing excitation energy. Excitation energies as high as 90% of those which would result from complete fusion are reached. The spectra of light particles detected in coincidence with residue groups having different average velocities are analyzed with a moving source fit. When recoil effects are properly taken into account, excellent fits to the data are obtained. From the energy spectra and multiplicities of particles emitted from a fusion-like source the initial temperatures of the primary composite nuclei are determined. The results suggest that a plateau temperature near 6.5 MeV is reached above excitation energies of 3 MeV/nucleon. The temperatures are compared to those resulting from various model calculations.

16443 **Subbarrier fusion of /sup 16/O+/sup 147,149/Sm.** DiGregorio, D.E.; diTada, M.; Abriola, D.; Elgue, M.; Etchegoyen, A.; Etchegoyen, M.C.; Fernandez Niello, J.O.; Ferrero, A.M.J.; Gil, S.; Macchiavelli, A.O.; and others. (Departamento de Fiiaasica-TANDAR, Comision Nacional de Energiiaaa Atomica, 1429 Buenos Aires, Argentina). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 516-523(Feb 1989).

Fusion cross sections have been measured for /sup 16/O+/sup 147,149/Sm at bombarding energies in the range 61 MeV ≦E/sub lab/(/sup 16/O)≦75 MeV by off-line observation of x rays emitted in the radioactive decay of Yb isotopes and their daughters. The fusion excitation functions are similar to those of the adjacent even Sm isotopes. It appears, therefore, that the odd valence neutrons do not have any unusual influence on the subbarrier enhancement of σ/sub fus/ in these systems. The x-n distributions of the evaporation residues were also determined. The nuclear deformation parameters β_2 deduced for the odd and even Sm isotopes using Wong's model establish a smooth systematic behavior of β_2 with target collectivity. Fusion cross sections for /sup 16/O with all the stable Sm isotopes are tabulated.

16444 **Level scheme of /sup 148/Pm and the s-process neutron density.** Lesko, K.T.; Norman, E.B.; Larimer, R.; Bacelar, J.C.; Beck, E.M. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 619-625(Feb 1989).

A level scheme of /sup 148/Pm up to 800 keV is deduced from gamma-ray coincidence data and published particle transfer data. Approximately 106 gamma-ray transitions have been placed between 36 levels. We have identified three levels below 500 keV in excitation which decay to both the ground state and to the isomeric level at 137 keV. The presence of these levels guarantees that /sup 148/Pm/sup g//sup ,//sup m/ are in thermal equilibrium during the s process. The s-process neutron density inferred from the branch point at /sup 148/Pm is deduced to be 3 x 10^8/cm^3.

16445 **Decay properties of /sup 153/Yb and /sup 153/Tm; Excitation energies of the s/sub 1/2/ and h/sub 11/2/ proton states in /sup 153/Tm.** Kortelahti, M.O.; Toth, K.S.; Vierinen, K.S.; Nitschke, J.M.; Wilmarth, P.A.; Firestone, R.B.; Chasteler, R.M.; Shihab-Eldin, A.A. (Louisiana State University, Baton Rouge, Louisiana 70803). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 636-644(Feb 1989).

The decay properties of /sup 153/Yb and /sup 153/Tm, produced in /sup 64/Zn bombardments of /sup 92/Mo, were investigated following on-line mass separation. A decay scheme, incorporating 34 transitions and 25 levels in /sup 153/Tm, was constructed for /sup 153/Yb. It establishes the s/sub 1/2/ proton level in /sup 153/Tm to be isomeric at an excitation energy of 43.2 keV. The α-decay branch of the h/sub 11/2/ /sup 153/Tm ground state was determined to be 91 +- 3%. In addition, a partial decay scheme was put together for the 9% β^+ branch. About 66% of this β^+ decay proceeds to the h/sub 9/2/ neutron state located at 299.3 keV in /sup 153/Er. Only one transition, 266.5 keV, could be assigned to the β^+ decay of the /sup 153/Tm s/sub 1/2/ isomer; it is suggested that the γ ray deexcites the p/sub 3/2/ neutron level to the f/sub 7/2/ /sup 153/Er ground state. Based on the intensity of this 266.5-keV γ ray, the isomer's α branch was estimated to be ~93%.

16446 **Dependence of /sup 12/B excitation energy on its kinetic energy in the /sup 14/N + Ag reaction at E/A = 35 MeV.** Deak, F.; Kiss, A.; Seres, Z.; Galonsky, A.; Gelbke, C.K.; Heilbronn, L.; Lynch, W.; Murakami, T.; Schelin, H.; Tsang, M.B.; and others. (Department of Atomic Physics, Eoetvoes University, H-1088 Budapest 8, Hungary). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 733-736(Feb 1989).

We observed the 19 keV neutron decay from the 3.388-MeV state of /sup 12/B by measuring /sup 11/B-neutron coincidences in colinear geometry at several angles. The ratio of this yield to the yield of particle-stable /sup 12/B nuclei is a measure of the excitation energy of /sup 12/B fragments produced in the reaction. The extreme kinematic focusing of the 19-keV decay enabled us to obtain the dependence of this ratio on fragment kinetic energy. For /sup 12/B nuclei emitted with kinetic energies E/Aapprox. <15 MeV the ratio is surprisingly constant; for /sup 12/B nuclei of higher kinetic energy it decreases monotonically.

16447 **Observation of a constant average angular momentum for fusion at sub-barrier energies.** Stokstad, R.G.; DiGregorio, D.E.; Lesko, K.T.; Harmon, B.A.; Norman, E.B.; Pouliot, J.; Chan, Y.D. (Nuclear Science Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720). *Physical Review Letters;* **62**: No. 4, 399-402(23 Jan 1989).

The cross sections for the fusion reaction /sup 128/Te(/sup 12/C,3n)/sup 137/Ce were measured from E/sub c.m./ = 34.5 to 50 MeV by observing the decay of the ground (J/sup π/ = $(3/2^+$, t/sub 1/2/ = 9.0 h) and isomeric ($(11/2^-$, 34.4 h) states in /sup 137/Ce. The isomer ratio decreases rapidly from a value of ≅34 at 47 MeV to an essentially constant value of ≅1.5 below 38 MeV. This confirms the prediction of an approximately constant value for the average angular momentum for fusion of heavy ions at energies well below the fusion barrier.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

16448 (INIS-SU—68, pp 540) **New estimation of nuclear physical characteristic values of /sup 170/Tm radionuclide.** Kuz'menko, N.K.; Nedovesov, V.G.; Chechev, V.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16449 (INIS-SU—68, pp 577) **Study on the /sup 188/Re γ-spectra.** Begzhanov, R.B.; Azimov, K.Sh.; Gureev, E.S.; Islamov, T.; Narzikulov, M.; Khodzhaev, M.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16450 **Observation of diabolical points in rapidly rotating nuclei.** Zhang, J.; Garrett, J.D. (University of Tennessee, Knoxville, Tennessee 37996). *Physical Review Letters;* **62**: No. 6, 693-693(6 Feb 1989).

A Comment on the Letter by R. S. Nikam and P. Ring, Phys. Rev. Lett. 58, 980 (1987).

16451 **Structure in the E2 quasicontinuum spectrum of /sup 154/Dy.** Holzmann, R.; Khoo, T.L.; Ma, W.C.; Ahmad, I.; Dichter, B.K.; Emling, H.; Janssens, R.V.F.; Drigert, M.W.; Garg, U.; Quader, M.A.; and others. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **62**: No. 5, 520-523(30 Jan 1989).

The evolution of the γ quasicontinuum spectrum with neutron number has been investigated in the sequence of isotopes /sup

152,154,156/Dy. The three nuclei display a pronounced collective E2 component. In /sup 154/Dy this component shows a splitting into two distinct parts, signifying a structural change along the γ cascade above the yrast line. The E2 and statistical components are reproduced in simple γ-cascade calculations; in /sup 152/Dy and / sup 156/Dy only rotational bands are included, whereas in /sup 154/Dy additional vibrationlike transitions are required to reproduce the two E2 peaks.

16452 **Comment on "Loss of collectivity at high spin in / sup 172/W and a three-band interpretation of first yrast upbends".** Raman, S.; NestorJr., C.W.; Kahane, S.; Bhatt, K.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **61**: No. 24, 2817-2817(12 Dec 1988).

A Comment on the Letter by M. N. Rao et al., Phys. Rev. Lett. 57, 667 (1986).

16453 **McGowan et al. reply.** McGowan, F.K.; Johnson, N.R.; Lee, I.Y.; Baktash, C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **61**: No. 24, 2818-2818(12 Dec 1988).

The previously measured B(E2) values is modified slightly due to normalization of the gamma-ray spectra data. (AIP)

6519 Nuclear Properties And Reactions, A=190-219, Experimental

16454 **(BNL—42194) Results from the BNL E802 spectrometer for 14.5 GeV/c per nucleon silicon beams.** Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Birstein, L.; Bloomer, M.A.; Bond, P.D.; Chasman, C.; Chu, Y.Y. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-8809203—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006177/JAW.

From Quark Matter '88: 7th international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, USA (26 Sep 1988).

We present selected results of measurements of inclusive π, K, proton, and deuteron spectra from 14.5 A GeV/c Si collisions with various targets. Results of neutral energy and charged particle dN/d{eta} measurements are also discussed. Large K to π ratios are observed in Si + Au collisions. Results are compared to the Lund-Fritiof model. 11 refs., 11 figs.

16455 **(CONF-8810264—4) π0 spectra and correlations from $_{16}$O + Au collisions at 200 A GeV.** Gutbrod, H.H.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Clewing, G.; Dragon, L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006421/JAW.

From Conference on hadronic matter in collision; Tucson, AZ, USA (6 Oct 1988).

The production of neutral pions by the interaction of 200 A GeV proton and ^{16}O projectiles with an Au target has been studied for 1.5 {<=} {eta} {<=} 2.1. Transverse momentum spectra have been measured between 0.4 GeV/c and 2.8 GeV/c and their dependence on the centrality of the reaction has been investigated. The peripheral spectrum shows a marked change of slope with a hard component starting at about 1.8 GeV/c in close similarity to p + p data. Preliminary analyses of photon data yield an excess over known photon sources for central data which is absent for peripheral reactions. Correlations of 4 photons representing neutral pions have been studied in ultrarelativistic heavy ion collisions. Data were taken in the WA80 experiment at the CERN-SPS with a 200 A GeV oxygen beam. The π^0 are detected via their decay photons with a high-granularity lead glass array. Special features of interferometry using neutral pions will be discussed. The extracted preliminary parameters for high p/sub T/ pions emitted near midrapidity in O + Au collisions lead to rather small effective source sizes. 23 refs., 8 figs.

16456 (IA—1440, pp 151-152) **Absolute cross sections for ground state (γ, n) transitions.** Birenbaum, Y.; Berant, Z.; Kahane, S.; Moreh, R.; Wolf, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16457 **Neutron decay from the giant resonance region in /sup 208/Pb.** Bracco, A.; Beene, J.R.; Bertrand, F.E.; Halbert, M.L.; Hensley, D.C.; Auble, R.L.; Horen, D.J.; Robinson, R.L.; Sayer, R.O. (Universita degli Studi di Milano, Dipartimento di Fisica, 20133 Milano, Italy). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 2, 725-728(Feb 1989).

The neutron decay of the giant multipole resonance region from 9 to 15 MeV of excitation energy in /sup 208/Pb has been studied. Neutron branching ratios for the decay to the ground state or to the low-lying excited states of /sup 207/Pb were measured as a function of the excitation energy of /sup 208/Pb and compared to Hauser-Feshbach calculations. While the neutron branching ratios from the isoscalar quadrupole resonance are reproduced by the calculations, the ratios from excitation energies above 12.5 MeV show a large excess with respect to the statistical predictions.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

16458 (INIS-SU—68, pp 532) **Conversion electron spectra of uranium-235 isomer in +4 and +6 oxide states.** Panov, A.D.; Zhudov, V.I.; Kulakov, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16459 (INIS-SU—68, pp 538) **Tables of standard reference data on characteristics of alpha-radiating radio nuclides used for graduation of alpha radiation spectrometers.** Medvedeva, S.A.; Nedovesov, V.G.; Stepanov, Eh.K.; Chechev, V.P.; Checheva, E.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/ JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16460 (INIS-SU—68, pp 554) **Np production in helium-3 interaction with /sup 235/U nucleus.** Gedeonov, A.D.; Pelevin, L.A.; Suprunenko, A.N.; Shkroev, V.Yu. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16461 **Transition radii and sum rules in /sup 238/ U(e,e'f).** Griffioen, K.A.; Van Bibber, K.; Calarco, J.R. (University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* **62**: No. 6, 689-689(6 Feb 1989).

A Comment on the Letter by Th. Weber et al., Phys. Rev. Lett. 59, 2028 (1987).

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 15656, 16246, 16408, 16409, 16427, 16441, 16443, 16775, 16785, 16786, 16787, 16788

16462 **(CBPF-NF—035/88) Some possible asymmetry effects of nuclear matter in relativistic heavy ion collisions.** Chung, K.C.; Wang, C.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705401/JAW.

The asymmetry dependence of nuclear incompressibility and that of nuclear critical temperature are calculated based on a Thomas-Fermi model with Seyler-Blanchard interaction. It is found that the asymmetry effects are big enought to allow for checking the existence of these effects in relativistic heavy-ion collision experiments.

16463 **(CEA-CONF—9314) Modern trends in the study of few-nucleon systems.** Frois, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Oct 1987. 20p. (CONF-8708143—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756640/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

The need to establish a link between the conventional mesonic description and QCD in the study of few-nucleon systems is reviewed and the nuclear many body problem is recalled. Few-nucleon systems are considered: the electromagnetic structure of the deuteron and of the trinucleon system. The proton momentum distribution of He/sup 3/ is illustrated. Quasi-elastic electron scattering is discussed. Research on hadron interactions in hadronic matter is seen as the key to advancing in this field.

16464 **(CEA-CONF—9438) Self consistent study of very high spin properties of /sup 80/Sr.** Bonche, P.; Flocard, H.; Heenen, P.H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique; Paris-11 Univ., 91 - Orsay (FR). Div. de Physique Theorique; Universite Libre de Bruxelles (BE)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). 1988. 5p. (CONF-880496—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756645/JAW.

From Conference on high-spin nuclear structure and novel nuclear shapes; Argonne, IL, USA (13 Apr 1988).

The HF + cranking method was used to study the spectrum of Sr80, which has a particularly complicated energy surface, with three different minima (oblate, prolate, triaxial). Only the high spin region is considered. The Yrast line and excited bands are illustrated. The variation of the quadrupole deformation of these bands is shown. To estimate the stability of the bands against fission, the energy variation of the bands was calculated as a function of the quadrupole moment at four angular momenta. The behavior of superdeformed bands of Sr80 is very similar to that of heavier nuclei. The production of neutron deficient isotopes with mass close to 80 in quasi-fusion reactions between stable nuclei seems feasible.

16465 **(CEA-CONF—9486) Deformed nuclear state as a quasi particle-pair.** Dobaczewski, J.; Skalski, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur - Yvette (FR); Warsaw Univ. (PL)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 10p. (CONF-8805256—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756647/JAW.

From 2. International spring Seminar on Nuclear Physics; Capri, Italy (16 May 1988).

The deformed nuclear states, obtained in terms of the Hartree-Fock plus BCS method with the Skyrme SIII interaction, are approximated by condensates of the low-angular-momentum quasiparticle and particle pairs. The optimal pairs are determined by the variation after truncation method. The influence of the truncation on the deformation energy and the importance of the core-polarization effects are investigated.

16466 **(CEA-CONF—9488) Nuclear deformation: a proton-neutron effect.** Dobaczewski, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 16p. (CONF-880639—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756648/JAW.

From International conference on contemporary topics in nuclear structure physics; Cocoyoc, Mexico (9 Jun 1988).

The Hartree-Fock plus BCS method with the Skyrme interaction is used to analyse the equilibrium deformations of nuclei in the A≈100 region. It is shown that the theoretical results are consistent with the N/sub n/N/sub p/ classification scheme. Relations between the nuclear deformation effects and the neutron-proton interaction are discussed.

16467 **(CEA-N—2560) Shape isomers in even-even nuclei: preliminary selection of candidates in the mass region a <208.** Girod, M.; Delaroche, J.P.; Berger, J.F. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). May 1988. 109p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756656/JAW.

This theoretical study is intended to establish a preliminary selection of non fissible even-even nuclei with mass number A < 208 for which the potential energy surfaces V (β) display a secondary minimum along an elongation coordinate β. Our selection relies upon a joint use of the Hartree-Fock-Bogoliubov and Strutinsky methods. The occurrence of secondary minima in V (β) maps is of critical importance for the formation of long life excited states (i.e. shape isomers) which most likely would decay into the γ channel. Our study shows that more than seventy nuclei in the vicinity of the stability line might develop shape isomerism.

16468 **(CEA-N—2582) On the initial particle-hole configuration in intermediate energy (30 < Ej < 140 MeV) photon induced pre-equilibrium reactions.** Ryckbosch, D.; Carlos, P., Lepretre, A. (Ghent Rijksuniversiteit (BE). Lab. Voor Kernfysica). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Nov 1988. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756658/JAW.

The existing photonuclear data, obtained with monochromatic photons in the energy region from 30 to 140 MeV, are analysed using the hybrid pre-equilibrium model. A parameter set, previously established for nucleon induced reactions, is used, the only parameter varied being the initial particle-hole configuration. Four possible initial states are examined: 1p - 1h (single-particle absorption), 2p - 1h (quasideuteron absorption with strong correlation of the holes), 2p - 2h (quasideuteron absorption without correlation) and two independent 1p - 1h cascades. It is shown that the existing experimental data do not allow for a discrimination between the various absorption mechanisms. New experiments are proposed.

16469 **(CRN-PN—87-25) Measurement of intermediate mass fragments in the fermi energy domain.** Rudolf, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 11p. (CONF-8710438—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756670/JAW.

From IN2P3 (France) - RIKEN (Japan) Workshop; Shimoda, Japan (12 Oct 1987).

Intermediate mass fragments in the Fermi energy domain were studied at GANIL via the Kr84 + Au reaction at 44 MeV/u. The Erel* quantity is used to study correlations between fragments. Fast-fast coincidences; fast-slow coincidences; slow-slow coincidences; and light particles are considered. Reaction mechanisms are discussed. Only qualitative analysis results are available, but they suggest that the quantitative results will be very instructive: light particle spectra will deliver source parameters (velocity, total charge, excitation energy and temperature); the multiplicity of intermediate mass fragments will be deduced from the triple coincidences between modules of XYZt detector.

16470 **(CSNSM-T—8703) Study of mercury isotopes in the A = 186 transition region.** Hannachi, F. (Paris-11 Univ., 91 - Orsay (France)). Oct 1987. 137p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756671/JAW.

High spin states in Hg 185-187-188 were investigated via the Dy 161-164 (Si28, xn) reactions, by in-beam gamma ray spectroscopy. Level schemes were established. Spins and parities of the states were deduced from transition multipolarities obtained from measurements of the angular distribution and linear polarization of the gamma rays. The shape coexistence of both oblate and prolate band structures built on states originating from the νi13/2 subshell is observed in Hg 185 and 187, as well as the rotational bands built on the 1/2/sup -/[521] and 7/2/sup -/[514] states in Hg 185. In Hg 188

negative parity bands are well developed. The various band structures are interpreted within the framework of the cranked shell model. The oblate structures are well reproduced by considering i13/2 excitations, while it is more difficult to draw conclusions about the nature of the particle involved in prolate structures.

16471 **(DOE/ER/13858—1) Energy related applications of elementary particle physics: Annual progress report, March 1, 1988--February 28, 1989.** Rafelski, J. (Arizona Univ., Tucson (USA). Dept. of Physics). 30 Nov 1988. Contract FG02-88ER13858. 6p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006886/JAW.

Steady progress is reported towards the understanding of how to increase the number of fusions per muon and how to decrease the cost of muon production for muon. A better understanding of muon sticking and regeneration was reached, amplifying the physical significance of the observed anomalously high fusion yield. New fusion systems involving $Z > 1$ nuclei are explored and found to have an unexpectedly high potential fusion yield. Extensive numerical calculations of muon regeneration and Monte Carlo simulations of muon production have been performed. The problem of muon sticking in d-t fusion has been theoretically addressed and novel numerical approaches are being developed.

16472 **(DOE/ER/40159—142) The structure of nuclei far from beta stability: Progress report.** Zganjar, E.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). [1989]. Contract FG05-84ER40159. 35p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006585/JAW.

This report contains papers on research of nuclear structure on far from stability nuclei. The areas discussed are on isotopes in the neutron deficient regions of Z=78,82, rare earth Z=57-72, and Z=50- 56. Experimental developments are also discussed. 37 refs., 10 figs. LSP

16473 **(DOE/ER/40264—3) Theoretical research in nuclear structure and nuclear collective motion: Progress report for the period March 1, 1988--February 29, 1989.** Klein, A. (Pennsylvania Univ., Philadelphia (USA)). Jan 1989. Contract FG02-86ER40264. 17p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006911/JAW.

This paper discusses the following topics: Large amplitude collective motion; Boson mappings of shell model algebras; Semiclassical approximations, TDHF, and heavy ion scattering; New approach to effective interactions; and Bound states in quantum electrodynamics. (LSP)

16474 **(DOE/ER/40365—2) Theoretical studies of intermediate-energy nuclear physics: Annual technical progress report, April 1, 1988--March 31, 1989.** Horowitz, C.J.; Macfarlane, M.H.; Serot, B.D. (Indiana Univ., Bloomington (USA)). 1989. Contract FG02-87ER40365. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006078/JAW.

In this period covered by this report (April 1, 1988 to March 31, 1989), work focused on six main areas: Relativistic Theories of Nuclear Structure and Saturation; Relativistic Descriptions of Proton- Nucleus and Electron-Nucleus Scattering; Nonrelativistic Theory of Nucleon-Nucleus Reactions; Gamow-Teller Excitations in Nuclear Charge- Exchange Reactions; Relativistic Many-Body Theory at Finite Temperature and Density and Relativistic Atomic Physics of High Z Atoms. Results and publications in these areas are summarized in this report.

16475 **(DOE/ER/40387—3) Potentials for calculating both parity states in p-shell nuclei.** Resler, D.A. (Ohio Univ., Athens (USA). John E. Edwards Accelerator Lab.). Jan 1989. Contract FG02-88ER40387. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006885/JAW.

A Hamiltonian employing a "physical" central two-body potential has been used for simultaneous calculation of both normal and non-normal parity states of p-shell nuclei. Normal parity states have been calculated in a full $0\{h\text{-bar}\}\omega$ space and non-normal parity states in a full $1\{h\text{-bar}\}\omega$ space with the effects of spurious center-of-mass states completely removed. No explicit core is used in any of the shell model calculations. Results are compared with experimental data and previous shell model calculations for the following nuclei: ^{4}He, /sup 5,6,7,8/Li, ^{8}Be, /sup 13,14/C, and ^{15}N. 34 refs., 9 figs., 3 tabs.

16476 **(GSI—88-63(prepr.)) Relativistic Vlasov equation with non-radiating meson fields.** Feldmeier, H.; Schoenhofen, M.; Cubero, M. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1988. 10p. (CONF-8810261—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From International workshop on nuclear dynamics at high energies; Bad Honner, F.R. Germany (10 Oct 1988).

The relativistic Vlasov equation which is coupled to wave equations for massive classical fields is solved in the spirit of the action-at-a-distance theory. It is argued that the acceleration of the nucleon due to the Hartree mean field is too small to produce free on-shell mesons by bremsstrahlung. An appropriate Green function allows one to construct radiation free solutions even for classical wave equations. The assumption of small accelerations is also used to achieve covariant equations of motion for test-particles which are the representatives of phase space cells. First results for the collision of two /sup 16/O nuclei are presented.

16477 **(GSI—88-65(prepr.)) Strangeness in ultra-relativistic heavy-ion collisions.** Friman, B.L. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1988. 13p. (CONF-8809203—). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.).

From Quark Matter '88: 7th international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, USA (26 Sep 1988).

Strangeness production in ultra-relativistic heavy-ion collisions is reviewed. The relative importance of strangeness production in the quark-gluon plasma phase, in the hadronic phase and during the hadronization transition is discussed and the effect of pion evaporation from the surface of the fireball is estimated. Results for K/π-ratios are given and compared with experiment.

16478 (IA—1440, pp 13) **Chemical-reaction theoretical approach to muon transfer processes.** Ohsaki, A.; Nakamura, H.; Baer, M. (Inst. for Nuclear Science, Myodaiji Okazaki (Japan). Division of Theoretical Studies; Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16479 **(IAE—4570/6) Intranuclear transitions in high-temperature plasma.** Arutyunyan, R.V.; Bol'shov, L.A.; Tkalya, E.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705443/JAW.

The electron-indiced intranuclear transitions in isomeric nuclei implanted in hot plasma are analyzed theoretically. These processes have been estimated for the individual isomers (/sup 242/Am, /sup 171/Lu, /sup 73/Se, /sup 110/Ag, /sup 183/W and /sup 96/Tc) with a level spaced by $\Delta E \leqq 2$ keV from the isomer one. 17 refs.; 6 figs.; 3 tabs.

16480 **(IAE—4634/2) Precise solution of three-nucleon problem with realistic NN interactions by the hyperspherical harmonics method. Comparison with other approaches.** Mukhtarova, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 40p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705451/JAW.

The three-nucleon ground state problem with realistic interactions is solved with high precision on the basic of hyperspherical

harmonics method. The properties of convergence and correlation of three nucleon observables are analysed. 35 refs.; 6 figs.; 12 tabs.

16481 **(IC—88/125) Mass-drift mode in /sup 238/U-induced quasi-fission reactions on targets of /sup 48/Ca, /sup 48/Ti, /sup 58/Fe and /sup 64/Ni using dynamical fragmentation theory.** Malik, S.S.; Singh, S.; Gupta, R.K. (Punjab Univ., Chandigarh (India). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1988. 25p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705337/JAW.

The phenomenon of large mass transfer between the reaction partners in collisions of /sup 238/U beam with various light targets is studied within the quantum mechanical fragmentation theory. It is found that the interaction barriers for most of the systems lie higher than the incident energy of 6 MeV/nucleon and compact mononuclear shapes, with thick necks, are formed in these reactions. Based on the fragmentation dynamics, a two-step model of "fission after a few nucleon transfer", proposed earlier by one of us for the quasi-fission reactions, is found to explain the observed mass distributions. The mass-drift mode in quasi-fission reactions is a dynamical effect due to shell corrections in potentials and inertial parameters. For lighter targets, the enhanced yields (bumps in mass distributions) at symmetry are shown to arise due to the dynamical liquid drop effect, associated with the compound-nucleus fission process, which becomes a dominant mode at higher incident energies due to the washing away of the shell corrections. The nature of possible dissipative forces and the question of "universality" of relaxation time for mass-asymmetry degree of freedom are also discussed. (author). 23 refs, 12 figs.

16482 **(IFT-P—15/88) Squeezed states phase space representation and semiclassical approximations in nuclear systems.** Mizrahi, S.S.; Galetti, D. (Sao Carlos Univ., SP (Brazil). Dept. de Fisica). (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705468/JAW.

We derive an alternative semiclassical approach (to the Wigner-Kirkwood method) for nuclear systems using a mapping scheme based on Squeezed States Phase Space Representation. The new expansion is applied to the usual harmonic oscillator case and the differences with the Wigner-Kirkwood results are discussed. (M.W.O.).

16483 **(IFUSP-P—689) Nature of the enhancement of sub-barrier heavy-ion fusion cross section: dispersion relation approach.** Franzin, V.L.M.; Hussein, M.S. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Jan 1988. 72p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705473/JAW.

Sub-barrier heavy-ion fusion reactions are discussed within an effective one-channel model, which contains channel coupling effects through the presence of an inclusive energy-dependent polarization potential IPP. With the aid of an inverse dispersion relation, which gives the imaginary part of the IPP in terms of the principal part integral involving the real part, the heavy-ion systems/sup A1/Ni +/sup A2/Ni and /sup 16/O + /sup A/Sm are analysed. In particular the reactive content of the extracted imaginary part of the IPP is discussed. The first and second moments of the angular momentum distribution of the partial fusion cross section are calculated and discussed.

16484 **(IFUSP-P—720) Study of the nuclear fusion of /sup 16/O +/sup 64,66/ Zn systems and elastic scattering in /sup 16/O +/sup 64,68/ Zn.** Tenreiro, C.F.; Acquadro, J.C.; Freitas, P.A.B.; Liguori Neto, R. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Jun 1988. 5p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705476/JAW.

An experimental study of /sup 16/O +/sup 64,66/ Zn reactions was made, centered in measurements of nuclear fusion from sub-coulomb barrier (Vb) energies up to near twice the V/sub b/. Further, elastic scattering angular distributions were obtained for the /sup 16/O +/sup 64,68/ Zn systems for energies near and above the V/sub b/. (M.W.O.).

16485 **(IKF-IB—70) Nuclear physics I. Course winter term 1987/88.** Elze, T. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). 1988. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756805/JAW.

This script consisting of two parts contains the matter of the courses Nuclear Physics I and II, as they were presented in the winter term 1987/88 and summer term 1988 for students of physics at Frankfurt University. In the present part I the matter of the winter term is summarized.

16486 **(IKF-IB—71) Nuclear physics II. Course summer term 1988.** Elze, T. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). 1988. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756806/JAW.

This script consisting of two parts contains the matter of the courses Nuclear Pyhsics I and II, as they were presented in the winter term 1987/88 and summer term 1988 for students of physics at Frankfurt University. In the present part II the matter of the summer term is summarized.

16487 **(IN2P3—8802) Far from the intermediate nuclear field.** Dietrich, K.; Wagner, G.J.; Gregoire, C.; Campi, X.; Silvestre-Brac, B.; Platchkov, S.; Mayer, B.; Abgrall, Y.; Bohigas, O.; Grange, P.; Signarbieux, C. (eds.). (Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France)). 1988. 378p. (In French). (CONF-8709402—). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88756679/JAW.

From The Joliot-Curie 1987 nuclear physics school; Maubuisson, France (14 Sep 1987).

Pairing correlations in nuclear physics; the BCS state and quasi-particles; the layer model; collision effects on nuclear dynamics; the theory of cluster formation (application to nucleus fragmentation); short range correlations (few-particle systems); deuterium electron scattering; dibaryonic resonances; traditional and exotic hadron probes of nuclear structure; spectral fluctuations and chaotic motion; corrections to the intermediate nuclear field (nonrelativistic and other effects); and heavy nuclei splitting and nuclear superfluidity are introduced.

16488 **(INDC(CPR)—013/LI) Preliminary analysis of neutron optical potential for A=40-60 below 10 MeV.** Su Zongdi. (Oxford Univ. (UK). Nuclear Physics Lab.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Dec 1988. 24p. (INT—88/1). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705492/JAW.

The variation of the total cross section σ/sub t/ and the absorption cross section σ/sub a/ with the parameters of the spherical optical potential (SOP) at low neutron energies for the nuclei in the region of the maximum strength function (A=40~60) has been studied. These results show that the dependence of σ/sub t/ and σ/sub a/ on the parameters of the SOP and neutron energy is very complicated. For the dependence of the cross section on the SOP, the real potential parameters are more sensitive than the imaginary potential ones, and the real potential depth V/sub 0/ and real radius parameter r/sub R/ are the most sensitive parameters in the SOP. The behaviours of the total cross section with varying SOP parameters depend strongly on the neutron energy and are very different for the different nuclei. The results have shown why the existing parametrizations do not give a good agreement with experimental data for low neutron energies in this mass region. The processes and results shown in this paper are significant to obtain the best parametrization for fitting the experimental data. (author). 18 refs, 27 figs.

16489 (INIS-mf—11348, pp 51) **Radioactive disequilibrium in nature: origin, facts and applications.** Adloff, J.P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jul 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16490 (INIS-mf—11348, pp 53) **Comparative study of the methods used to measure dead time.** Vega Carrillo, H.R.; Gamboa Gonzalez, H. (Universidad Autonoma de Zacatecas (Mexico). Centro Regional de Estudios Nucleares). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16491 (INIS-SU—66, pp 49-58) **New results on the formation of fission fragment distributions in the diffusion model.** Adeev, G.D.; Pashkevich, V.V.; Pischasov, N.I.; Serdyuk, O.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01; INIS. Order Number DE89780045/JAW.

Voprosy Atomnoj Nauki i Tekhniki.; no. 1.

In Nuclear constants. Scientific-technical collection.

The results of calculations of the mass-kinetic energy distributions of fission fragments are reviewed. The calculations are based on the Fokker-Planck equation for the distribution function of most important collective coordinates. The dependence of the model results and the values characterising the dynamics of descent of fissioning nucleus from the saddle point to the scission on the choice of the main dynamical coefficients is investigated. The influence of large angular momentum of the compound nucleus on the mass-kinetic energy distributions of fragments is considered. 42 refs.; 6 figs.; 1 tab.

16492 (INIS-SU—68, pp 559) **Laser technique for orientation of free atom nuclei.** Barabanov, A.L. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16493 (INIS-SU—68, pp 569-570) **Analysis of γ-quanta angular correlation perturbed by combined hyperfine interaction (J=5/2).** Komissarova, B.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16494 (INIS-SU—68, pp 581) **Consistent systematics of level densities for intermediate mass and heavy nuclei.** Grudzevich, O.T.; Ignatyuk, A.V.; Plyaskin, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16495 (INIS-SU—68, pp 582) **Hexadecapole degrees of freedom for deformed nuclei in the frameworks of the self-consistent phonon model.** Barts, B.I.; Shlyakhov, N.A.; Utenkov, S.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16496 (INIS-SU—68, pp 583) **Nonlinear quadrupole oscillations of krypton isotopes.** Bolotin, Yu.L.; Gonchar, V.Yu.; Tarasov, V.N.; Chekanov, N.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16497 (INIS-SU—68, pp 584) **Accounting for complex configurations in near magic nuclei by the method of chronological uncoupling of diagrams.** Tselyaev, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16498 (INIS-SU—68, pp 585) **Analysis of an equation for the response function with separation of correlations in pp- and ph-channels.** Tkachev, V.N.; Tselyaev, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16499 (INIS-SU—68, pp 588) **Isospin structure of the / sup 30/P resonance states.** Kachan, A.S.; Nemashkalo, B.A.; Storizhko, V.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16500 (INIS-SU—68, pp 560) **Estimated values of reaction cross section used at proton flux monitoring.** Vukolov, V.A.; Chukreev, F.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16501 (INIS-SU—68, pp 595) **Fusion cross sections in heavy ion reactions for nuclear-nuclear potential in the sudden approximation.** D'yachenko, A.T.; Rubchenya, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16502 (INIS-SU—68, pp 596) **Analysis of the total experiment in elastic scattering of intermediate-energy protons by nuclei with spin 1/2.** Kudryavtsev, I.N.; Soznik, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16503 (INIS-SU—68, pp 597) **Effects of dibarion resonances in deuteron electrodisintegration.** Rekalo, M.P.; Gakh, G.I.; Rekalo, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16504 (INIS-SU—68, pp 598) **Total set of polarization characteristics of 500 MeV protons elastically and inelastically scattered by /sup 40/Ca and /sup 208/Pb nuclei.** Berezhnoj, Yu.A.; Molev, A.S.; Soznik, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16505 (INIS-SU—68, pp 599) **Polarization phenomena in proton elastic scattering by oxygen nuclei and α-particle model with dispersion.** Berezhnoj, Yu.A.; Mikhajlyuk, V.P.; Pilipenko, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16506 (INIS-SU—68, pp 587) **M1 resonance in nuclei of sd-shell.** Kachan, A.S.; Nemashkalo, B.A.; Storizhko, V.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16507 **(IPNO-TH—87-86) Role of giant resonance excitation in heavy ion collisions.** Catara, F.; Chomaz, Ph. (Messina Univ. (IT). Inst. di Fisica; Istituto Nazionale di Fisica Nucleare, Catania (IT)). (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756879/JAW.

In this paper we discuss several aspects of heavy ion collisions involving collective vibrational modes. In our approach the relative motion is treated in a semiclassical approximation, while the intrinsic degrees of freedom are described microscopically within the RPA. The differences with respect to macroscopic models are analyzed in the appendix. First we present some results on the inelastic scattering cross section and we show that the structures observed experimentally can be explained in terms of multiple excitation of the Giant Quadrupole Resonance. After we calculate an adiabatic polarization potential describing the coupling to the collective vibrational modes and show that it produces a strong enhancement of the subbarrier fusion cross section. This enhancement is found to be enough to reproduce the experimental data for symmetric systems, while for asymmetric reactions the coupling to other degrees of freedom, like transfer, is needed. Finally we report some preliminary results on a dynamical calculation of the real and imaginary parts of the polarization potential. We show that at high incident energies (E/A > 20MeV) the role of the Giant Quadrupole Resonance becomes dominant.

16508 **(KFK—4453) Extended sum-rule model for intermediate mass-fragment emission.** Brancus, I.M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Oct 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756815/JAW.

A survey is given on the basis of sum-rule models describing the intermediate mass-fragment emission in light and heavy ion reactions. The original sum-rule worked out by Wilczynski et al. has been extended by a term accounting for the dynamical behaviour of the dinuclear system and dependent on the critical value of the orbital angular momentum for the fusion with dissipation. This term proves to be rather essential in reproducing the Z-distribution of the fragments emitted from rather asymmetric systems. The features of the model are demonstrated by applying it to /sup 40/Ar+/sup nat/Ag, /sup 40/Ar+/sup 154/Sm, /sup 40/Ar+/sup 197/Au, /sup 40/Ar+/sup 232/Th (E=336 MeV), and to /sup 6/Li+/sup 46/Ti, /sup 6/Li+/sup nat/Cu, /sup 6/Li+/sup nat/Ag (E=156 MeV) reactions.

16509 **(LBL—25371) Nuclear dissipation and the order to chaos transition.** Swiatecki, W.J. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 19p. (CONF-8806117—11). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006663/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

The transition from ordered to chaotic nucleonic motions in the nuclear mean-field potential is reflected in the disappearance of shell effects in nuclear masses and deformations, and in the transition from an elastic, through an elastoplastic, to a dissipative behavior of the nucleus. 23 refs., 10 figs.

16510 **(MPI-H—1988-V-27) Nuclear beta decay far from stability and astrophysics.** Klapdor, H.V. (Osaka Univ. (Japan). Dept. of Physics; Tokyo Inst. of Tech. (Japan)). (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.); Tokyo Inst. of Tech. (Japan)). 1988. 17p. (CONF-880795—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756818/JAW.

From Tokyo symposium on heavy-ion and nuclear astrophysical problems; Tokyo, Japan (19 Jul 1988).

Beta decay data of nuclei far from stability are one of the most important nuclear physics input for the understanding of the element systhesis in the universe and determination of the age of the universe from cosmochronometers and by the latter have implications also for cosmology. The present status of theoretical predictions of beta decay far from stability will be reviewed and the impact on the above astrophysical questions will be outlined. First results of second generation microscopic calculations of β/sup F/ half lives, which are at present in progress, will be presented.

16511 **Electron pair production from pulsed electromagnetic fields in relativistic heavy-ion collisions.** Bottcher, C.; Strayer, M.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 5, 1330-1341(1 Mar 1989).

We present calculations of the electron pair production cross sections in relativistic heavy-ion collisions. The electron pairs arise from the decay of vacuum excitations induced by the very strong and sharply pulsed electromagnetic fields near nuclei which collide at relativistic velocities. We present an exact Monte Carlo evaluation of the two-photon terms describing this process, and we discuss at length the inadequacies of the approximation schemes that are inherent to the usual virtual-photon approaches. Typical results for collisions corresponding to experiments at the BNL Alternating Gradient Synchrotron, CERN, and the Relativistic Heavy Ion Collider are discussed.

16512 **Extrapolation of the dispersive optical model to the resonance region for neutrons on /sup 86/Kr.** Johnson, C.H.; Carlton, R.F.; Winters, R.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 415-425(Feb 1989).

The neutron-/sup 86/Kr mean field is formulated in terms of a dispersive optical model potential in which the real part contains dispersive contributions derived from the imaginary part by the dispersion relation. The dispersive contribution is added to the Hartree-Fock potential, which is assumed to have a Woods-Saxon shape and a depth that decreases linearly with increasing energy. The shape parameters for all components of the potential are assumed to be independent of energy. The model is formulated in terms of the energy relative to the Fermi energy, and the imaginary potential is assumed to be symmetric about the Fermi energy, which is set equal to -7.7 MeV on the basis of the empirical level structure for n-/sup 86/Kr. All other parameters are taken from earlier analyses of other nuclei, particularly of /sup 89/Y. The model is shown to give good overall predictions for the n-/sup 86/Kr mean field by comparison to the following three sets of empirical data: (i) the observed energies of the occupied and unoccupied valence levels, (ii) the energy-averaged total cross section for neutron energies up to 25 MeV, and (iii) the averaged scattering functions for s-, p-, and d-wave neutrons in the resolved resonance region from 0.015 to 0.96 MeV. The latter comparison is the unique feature of this work; the partial-wave-scattering functions that are available for s, p, and d waves in the resonance region for /sup 86/Kr make possible detailed comparisons to the scattering functions from the model.

16513 **Separable representation of the two-body Reid soft core T operator in terms of positive energy Weinberg states.** Rawitscher, G.H. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 440-451(Feb 1989).

A separable approximation T/sup (//sup S//sup)/ to the two-body T matrix of the form $<kT/sup (S)/(E)k'> = <kVk'> + \Sigma/sup S//sub s//sub //sub = /_1 <kV\Gamma/sub s/(E)>(1-\gamma/sub s/)/sup -1/ <\Gamma/sub s/(E)Vk'>$ is examined, where V is the Reid soft core potential, Γ/sub s/ are the Weinberg eigenstates of the operator $G_0(E)V$ for positive energy E, and γ/sub s/(E) are the corresponding discrete complex eigenvalues. General projection techniques which improve the convergence of the sum above are considered. For the triplet state a nonlocal potential U is defined which in the l = 0 channel represents the effect of the tensor coupling to the l = 2 channel. It is found that the presence of U in the

triplet state is responsible for the increased number of terms needed in the separable representation of T, as compared to the representation in the singlet state, where U is absent. The effect of U is largest for momenta less than 1 or 2 fm/sup -1/. .AE

16514 **Lambda-neutron interaction in kaon photoproduction from the deuteron.** Adelseck, R.A.; Wright, L.E. (Physics Department, Ohio University, Athens, Ohio 45701). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 580-586(Feb 1989).

The importance of hyperon-nucleon final-state interaction in kaon photoproduction from the deuteron is examined. By calculating the deuteron wave function using the Reid, Paris, or Bonn NN potentials, the uncertainty of this process due to the nucleonic wave function is found to be negligible. The insignificance of off-shell and relativistic effects is demonstrated by employing a completely relativistic wave function and comparing various approximations. We find the influence of the kaon production operator to be the most critical ingredient in this calculation. Final-state effects, which are included via a distorted-wave formalism, involve partial waves up to l = 3. They produce a sharp rise of the cross section near threshold resulting in an enhancement by about a factor of 3, but diminish rapidly as the energy increases. Different ΛN potential models show variations of the effect by up to 10%.

16515 **Use of inelastic pion scattering to study isospin mixing in nuclei.** Hayes, A.C. (Theoretical Physics Institute, School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 699-700(Feb 1989).

Nuclear structure effects are shown to play a significant role in determining the pion asymmetries expected for the excitation of isospin mixed states. As an example, the π^+/π^- ratio for excitation of the giant dipole resonance region in ^{4}He is calculated. It is shown that, at the peak of the angular distribution (θ/sub lab/ = 30°), no significant deviation from unity is expected for the pion ratio if the isospin mixing is at the level of 5%.

16516 **Pion charge exchange and the optical theorem.** Koltun, D.S.; Singham, M.K. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 2, 704-707(Feb 1989).

We give some applications of the optical theorem (and its extensions) to charge exchange reactions of pions between isobaric analog states of nuclear targets, based on isospin invariance. We then derive an inequality, valid in the strong absorption limit, to give a bound on reaction channels which may be contributing to the isotensor optical potential, at pion energies near the 3,3 resonance. We further show that coupling to pion absorption on T = 1 pairs may provide a major component of this potential.

16517 **Many-body effects in the (e,e'p) reaction.** Takaki, T. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical P.eview Letters;* **62**: No. 4, 395-398(23 Jan 1989).

We present the first quantitative study of the final-state-interaction effect in the missing-energy spectrum measured in a coincidence /sup 12/C(e,e'p) experiment in the dip region. It is found that the calculated cross section for the two-body type of final-state interaction is very small compared with the data. Furthermore, it decreases with increasing missing energy; this qualitative behavior does not agree with the data. From qualitative investigation, the presence of the many-body mechanism involving more than two nucleons is suggested.

16518 **New droplet model developments.** Dorso, C.O.; Myers, W.D.; Swiatecki, W.J.; Moller, P.; Treiner, J.; Weiss, M.S. (Nuclear Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US));. pp v of Nuclear physics: Recent trends and developments. Wilhelmi, Z.; Szeflinska, G.; Kicinska-Habior, M. New York, NY; Harwood Academic Pub. (1987). (CONF-8509159—).

From 17. international summer school on nuclear physics; Mikolajki, Poland (2 Sep 1985).

A brief summary is given of three recent contributions to the development of the Droplet Model. The first concerns the electric dipole moment induced in octupole deformed nuclei by the Coulomb redistribution. The second concerns a study of squeezing in nuclei and the third is a study of the improved predictive power of the model when an empirical "exponential" term is included.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 14723, 14731, 14738, 15323, 15327, 15411, 15467, 15884, 16137, 16827, 16869, 16869

16519 **(INFN-TC—88-25) Analytical treatment of the spin splitter.** Conte, M.; Penzo, A.; Pisent, A.; Pusterla, M. (Istituto Nazionale di Fisica Nucleare, Genoa (Italy); Istituto Nazionale di Fisica Nucleare, Trieste (Italy); Istituto Nazionale di Fisica Nucleare, Padua (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 28p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705503/JAW.

The spin-orbit coupling associated with the interaction of the magnetic of proton-antiproton, circulating in a low energy storage ring, with appropriate field gradients of quadrupole elements in the machine, is studied analytically. The conditions for a separation of opposite spin states are discussed and methods are proposed for working at very low energies. 5 figs.

16520 (INIS-mf—11351, pp 164-168) **Measurement of number albedo for backscattered 662 keV photons from stratified layers of concrete and lead.** Bhattacharjee, A.; Sinha, A.K. (Regional Engineering Coll., Silchar (India)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A suitable combination of stratified layers of different materials and thicknesses was found to increase the shielding property for gamma rays. Albedo was used in such measurements as a parameter for the integral measure of gamma ray scattering. The Uniform Sensitivity Photon Counter designed indigeneously was used in the present investigation. This Counter has an advantage over multichannel analyzers since results are obtained in a straightforward manner and do not require response correction by the inverse matrix method as is the case with a multichannel analyzer. The differential and total number albedo values for the stratified slabs of concrete and lead at 662 keV energy are reported. (author). 6 figs., 2 tabs., 10 refs.

16521 (INIS-SU—64, pp 28-32) **Adaptive balance integration algorithm for solving the problems of radiation transport in spherical configuration.** Dubinin, A.A.; Kurachenko, Yu.A.; Frolov, O.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

A complex adaptive algorithm for numerical solving the problems of radiation transport based on characteristic method and combining its advantages and merits of balance algorithms is suggested. A priori information on peculiarities of radiation transport in the reactor energy range through high-thick spherical shielding layers is taken into account when developing the algorithm. Results of calculation of the energy accumulation factors for the 8 MeV point isotropic photon source in iron sphere are presented. The given algorithm with the corresponding modification may be used for solving the problems of neutron transport. 5 refs.; 4 figs.; 2 tabs.

16522 (INIS-SU—64, pp 32-38) **Optimal calculational schemes for solving multigroup photon transport problem.** Dubinin, A.A.; Kurachenko, Yu.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

A scheme of complex algorithm for solving multigroup equation of radiation transport is suggested. The algorithm is based on using the method of successive collisions, the method of forward scattering and the spherical harmonics method, and is realized in the FORAP program (FORTRAN, BESM-6 computer). As an example the results of calculating reactor photon transport in water are presented. The considered algorithm being modified may be used for solving neutron transport problems. 5 refs.; 2 tabs.

16523 (INIS-SU—64, pp 39-44) **Analysis of some splitting and roulette algorithms in shield calculations by the Monte Carlo method.** Korobejnikov, V.V.; Aleshechkin, V.N. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

Different schemes of using the splitting and roulette methods in calculation of radiation transport in nuclear facility shields by the Monte Carlo method are considered. Efficiency of the considered schemes is estimated on the example of test calculations. 13 refs.; 2 figs.; 2 tabs.

16524 (INIS-SU—68, pp 558) **Distortion of gamma spectra in passing through aluminium filter.** Dushin, V.N.; Khlebnikov, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16525 **(LA—11501-PR) Radiation transport: Progress report, April 1, 1988--June 30, 1988.** O'Dell, R.D.; Byers, H. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006780/JAW.

Research and development progress in radiation transport for the Los Alamos National Laboratory's Group X-6 for the third quarter of FY88 is reported. Included are unclassified tasks in the areas of Deterministic Radiation Transport, Monte Carlo Radiation Transport, and Cross Sections and Physics. 37 refs., 7 figs., 3 tabs.

16526 **(LA-UR—88-4136) Rf measurements at Project Rose.** Buchenauer, C.J.; Armstrong, W.T.; Kelly, M.S.; Knox, S.O. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 21p. (CONF-881251—1). NTIS, PC A03 - OSTI. Order Number DE89005461/JAW.

From Final data review meeting on project rose; Livermore, CA, USA (13 Dec 1988).

The Los Alamos team made rf measurements of Project Rose from April 30--May 6, 1987. Measurements were made with broad-band B-dot detectors on a mast 40 ft above the north end of the hill-top diagnostic pad. Details of the radiated field waveforms were observed to depend upon beam operating conditions. Distinct differences were observed for stable versus unstable operation and for operation with targets in place. The initial pulse shape and amplitude was predicted from standard transition radiation theory, when modified to account for numerous ground reflections. The sensitivity to ground reflections was so strong that observers at slightly different locations are likely to have seen very different rf signatures. Other rf radiation associated with the test was also observed. Long after the e-beam should have dissipated, a low frequency ({approximately}7 MHz) vertically polarized ringing E-field was observed. This was probably due to a structural resonance of the building excited by the redistribution of image charges at the beam exit plane. Also included is data illustrating the importance of the beam exit geometry on the measured rf signature. The text of this paper is presented as extensive captions accompanying each figure. 15 figs.

16527 **(RTS-R—002) MARC/PN. A computer program to solve the multigroup neutron transport equation.** Fletcher, J.K. (UKAEA Risley Technical Services, Risley (UK)). Jul 1988. 120p. NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705396/JAW.

In Part 1 of the report a description of the basic method will be found followed by details of the finite difference and finite element techniques employed. To facilitate explanation of the anisotropic scatter treatment an alternative derivation of the equations based on the generalized least squares approach leads to details of the relevant algorithm. Part 1 continues with the derivation of a general perturbation formula then, because they form the basis of the method, a summary of the properties of spherical harmonics and concludes with appendices containing FORTRAN routines illustrating some of the novel techniques used in the code. Part 2 comprises a programmer's guide.

16528 **Monte Carlo shielding analyses using an automated biasing procedure.** Tang, J.S.; Hoffman, T.J. (Oak Ridge National Lab., Computing and Telecommunications Div., P.O. Box X, Oak Ridge, TN (US));. *Nuclear Science and Engineering;* **99**: No. 4, 329-342(Aug 1988).

A systematic and automated approach for biasing Monte Carlo shielding calculations is described. In particular, adjoint fluxes from a one-dimensional discrete ordinates calculation are used to generate biasing parameters for a Monte Carlo calculation. The entire procedure of adjoint calculation, biasing parameters generation, and Monte Carlo calculation has been automated. The automated biasing procedure has been applied to several realistic deep-penetration shipping cask problems. The results obtained for neutron and gamma-ray transport indicate that with the automated biasing procedure Monte Carlo shielding calculations of spent-fuel casks can be easily performed with minimum effort and that accurate results can be obtained at reasonable computing cost.

16529 **Preliminary neutronics analysis of an inboard tritium-breeding shield for TIBER II - ETR.** Varsamis, G.L.; Steiner, D.; Embrechts, M.J. (Nuclear Engineering Dept., Rensselaer Polytechnic Institute, Troy, NY (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

Fusion researchers both in the US and abroad are now examining next-generation fusion machines which have as their primary goal the testing of fusion reactor components. The current design for a next generation device in the US has been designated at "TIBER II - ETR". The present study examines the neutronics performance of an inboard tritium-breeding shield based on the Aqueous Self Cooled Blanket concept. Two alternative designs for the inboard of TIBER II are examined, on based on a tungsten/aqueous solution scheme and the other on a beryllium/tungsten/aqueous solution option. Both designs yield adequate shielding and substantial tritium breeding. It is observed that in tungsten-based systems accurate tritium breeding calculations require the inclusion of both spatial and energy self-shielding.

16530 **Sensitivity/uncertainty analysis for the Nagasaki dosimetry reevaluation effort.** Lillie, R.A.; Broadhead, B.L.; Pace, J.V. III; Cacuci, D.G. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

Uncertainties have been calculated for the Nagasaki free-in-air (FIA) tissue kerma obtained from two-dimensional air-overground (A/G) transport calculations. The uncertainties due to modeling parameter and basic nuclear transport data uncertainties were calculated for ground ranges of 700, 1000, and 1500 m. Uncertainties of approximately 20% were obtained for the prompt neutron and secondary gamma kerma and 30% for the prompt gamma kerma. In general, the uncertainties are dominated by the modeling parameter uncertainties, particularly those associated with the weapon yield and radiation sources.

16531 **Shielding calculations at dismantled syncrocyclotron.** Yalcintas, M.G. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

The Space Radiation Effects Laboratory located in Newport News, Virginia, was operated by the College of William and Mary for the National Aeronautics and Space Administration. A synchrocyclotron was formerly in operation in this building was removed in 1980. At several locations, the scattered radiation caused an induced radioactivity within the walls of the cyclotron room. A radiological survey has been performed to determine the amount of residual radioactivity on the walls. Calculations were performed to determine the thickness of the concrete walls and floor for shielding the residual radiation in the cyclotron room. Recommendations are made to minimize exposures from the residual radioactivity on the walls and floor of the cyclotron room to potential occupants working in the building.

16532 **Automated shielding analysis sequences for spent fuel casks.** Tang, J.S.; Parks, C.V.; Hermann, O.W. (Oak Ridge National Lab., Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

Two important Shielding Analysis Sequences (SAS) have recently been developed within the SCALE computational system. These sequences significantly enhance the existing SCALE system capabilities for evaluating radiation doses exterior to spent fuel casks. These new control module sequences (SAS1 and SAS4) and their capabilities are discussed and demonstrated, together with the existing SAS2 sequence that is used to generate radiation sources for spent fuel. Particular attention is given to the new SAS4 sequence which provides an automated scheme for generating and using biasing parameters in a subsequent Monte Carlo analysis of a cask.

16533 **Intercomparison of cross-section libraries used for spent fuel cask shielding analyses.** Parks, C.V.; Broadhead, B.L.; Roussin, R.W.; Gauthey, J.C.; Cramer, S.N.; Kirk, B.L. (Oak Ridge National Lab., Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A study has been made to compare the surface dose rates obtained from one-dimensional analyses of an iron-shielded spent fuel cask using a variety of available broad- and fine-group cross-section libraries. MCNP analyses using point cross-section data were also performed. Alternate versions of the broad-group libraries were developed to study the effect of resonance shelf-shielding, group structure, weighting spectrum, and data origin (ENDF/B-IV versus ENDF/B-V)). The results presented indicated significant discrepancies in the final doses. The discrepancies are evidently due to inadequate resonance self-shielding treatment and improper weighting spectra for the fine-group collapse. Discrepancies between the fine-group results and the point data results are also observed.

16534 **Comparison of air-over-ground methods.** Mendelsohn, E. (Lawrence Livermore National Lab. (LLNL) (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

An important ingredient in the most recent radiation dose estimates (DS-86) for the Hiroshima and Nagasaki A-Bomb survivors is the results of prompt neutron and gamma transport calculations in an air-over-ground geometry. These calculations were carried out in two parallel efforts; using the DOT (SN method) computer code, and utilizing the TART (Monte Carlo method) computer code. In providing these parallel efforts it was hoped that any discrepancies due to calculation methods, different cross section libraries, inappropriate material or geometry definitions, or computer program input errors would be discovered at an early time. Reasonable agreement between the results from the two codes would then enhance confidence in our calculations. Here the authors provide an overview of the TART Monte Carlo code capabilities, briefly describe how their TART problems were constructed and compare their results with those from DOT. The authors also present results of two calculations which show some of the special capabilities of TART, namely a sulfur calculation in a 3-dimensional geometry and a time dependent cobalt activation calculation.

6550 Medical Physics

REFER ALSO TO CITATION(S) 14401, 15847, 15849, 15970, 15972, 15973, 16045, 16136

16535 **(CEA-tr—2270) Self absorption coefficients of monoenergy monooriented radiation emitted by cylindrical source.** Dvoretskii V.G.; Smirnov, V.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1987. 13p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756666/JAW.

Self absorption coefficient of gamma radiation emitted by collimated cylindrical sources with a central channel is calculated. Experimental verification agrees with results.

16536 (CONF-870155—, pp 345-371) **Track structure: Cross sections, averages and fluctuations.** Katz, R. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

When we seek to predict the response of a detector to energetic heavy ions many confusion images are called to mind. Visible tracks of protons in nuclear emulsions suggest that the random sequence of developed grains along the presumed proton path arises from the fluctuation of energy depositions. Monte Carlo track calculations display large differences from segment to segment. Macroscopic irradiations are normalized to dose, yet there are large fluctuations in microscopic energy depositions in small volumes of biological significance. These lead to the view that knowledge of the fluctuation in energy deposition in small, appropriately sized, subvolumes of a medium is prerequisite to prediction of detector response. A track structure model based on the average radial distribution of energy deposition, which avoids any distinction between track core and penumbra, which makes no mechanistic assumption about the nature of the interactions between radiation and detector, has had extensive success. We will see that fluctuations in energy deposition are an implicit part of a model based on averages. By constructing the model carefully we avoid the pitfalls of an unwarranted emphasis on mechanism and on the details of the fluctuation of energy deposition. 13 refs., 12 figs.

16537 (IA—1440, pp 268-270) **Occupational radiation exposure in Israel in 1987.** Malchi, S.; Shamai, Y.; Schlesinger, T.; Israeli, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16538 (IA—1440, pp 315) **Recent data on lead isotope measurements.** Platzner, I. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16539 (INIS-mf—11351, pp 98-104) **Slow neutron flux distribution in phantom irradiated by collimated beams of / sup 252/Cf neutrons.** El-Bakkoush, F.A.; Akki, T.S.; Megahid, R.M. (Tajura Nuclear Research Centre, Tripoli (Libya)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Measurements were carried out to study the attenuation and distribution of slow neutron fluxes at various positions in a tissue-like phantom irradiated with a collimated beam of /sup 252/Cf neutrons. Water was chosen as a simulated material to soft tissue because its nuclear composition and effective atomic number nearly correspond to the composition of soft tissue. The phantom under investigation was a polyethylene tank filled with water. Collimated direct and boron carbide filtered neutron beams were used. The neutron flux was measured using /sup 115/In (n,γ)/sup 116/In activation detectors. The measured data are presented in form of attenuation curves along the beam axis and in planes vertical to the beam direction. These attenuation curves were used to construct groups of isoflux curves in the plane containing the axis of the incident beam. In addition, the results obtained for the collimated disc are converted to those which can be obtained when the phantom is irradiated from are infinite planar monodirectional source. The conversion was made by integrating the measured flux distribution along the vertical directions. The obtained results can be used to evaluate the slow neutron depth distribution at various locations within and outside the beam vicinity. The results also give the dependence of the side scattered neutrons on the beam diameter and tissue depth. (author). 4 figs., 12 refs.

16540 (INIS-mf—11351, pp 162-164) **Doses to personnel engaged in radiation treatment of cancer patients in Kuwait during 1980-85.** Bakir, Y.Y.; Al-Zenki, S.D.; Sabol, J. (Ministry of Public Health, Kuwait (Kuwait). Radiation Protection Division). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

Data is tabulated concerning the number of radiation workers in Kuwait between 1980 and 1985, the annual dose distribution for radiation personnel in general and for radiotherapy personnel in particular, and the annual average and collective doses for all radiation workers. The tables show that the annual average doses for radiotherapy personnel did not exceed the average for all radiation workers monitored and with the exception of 1980, were considerably below the limits given by ICRP recommendations. (L.O.). 4 tabs.

16541 (INIS-mf—11351, pp 82-86) **Dosimetry of new / sup 137/caesium sources before their application to clinical practice.** Zackova, H.; Kubec, V.; Stankusova, H.; Stopek, K.; Slonc, T. (Institut pro Dalsi Vzdelavani Lekaru a Farmaceutu, Prague (Czechoslovakia); Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). Aug 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705527/JAW. (CONF-8609339—).

From 2. symposium of radiological physicists; Smolenice, Czechoslovakia (22 Sep 1986).

A comparison is made of /sup 137/Cs sources of CMJ and CMT types of Czechoslovak production with similar CDC-J and CDCS-J sources manufactured by Amersham of Great Britain. Next to external dimensions the design was checked of the sources using autoradiography and X-ray radiography. The activity of the sources was measured and their quality determined (impurity content). Two calculation models were used for the calculation of dose distribution in the model and the obtained results were compared with published data. It was found that the Czechoslovak /sup 137/Cs source for clinical use has satisfactory parameters and its quality is comparable with the British source. (E.S.). 6 figs., 7 refs.

16542 (INIS-XN—149) **Optimisation of radiation protection.** (Nuclear Energy Agency, 75 - Paris (France)). 1988. 219p. (CONF-8803179—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW.

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

Optimisation of radiation protection is one of the key elements in the current radiation protection philosophy. The present system of dose limitation was issued in 1977 by the International Commission on Radiological Protection (ICRP) and includes, in addition to the requirements of justification of practices and limitation of individual doses, the requirement that all exposures be kept as low as is reasonably achievable, taking social and economic factors into account. This last principle is usually referred to as optimisation of radiation protection, or the ALARA principle. The NEA Committee on Radiation Protection and Public Health (CRPPH) organised an ad hoc meeting, in liaison with the NEA committees on the safety of nuclear installations and radioactive waste management. Separate abstracts were prepared for individual papers presented at the meeting.

16543 (INIS-XN—149, pp 11-36) **Critical overview of the development of the optimization requirement and its implementation.** Gonzalez, A.J. (International Atomic Energy Agency, Vienna (Austria)). 1988. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW. (CONF-8803179—).

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

This paper is intended to provide a critical overview of the development of the optimization requirement of the system of dose limitation recommended by the International Commission on Radiological Protection (ICRP), as well as of its implementation. The concept of optimization began to evolve in the mid-1950s and was formally introduced as a requirement for radiation protection in 1978. Recommendations on its practical implementation have been available for five years. After such a long evolution, it seems reasonable to make a critical assessment of the development of the optimization concept, and this summary paper is intended to provide such an assessment. It does not include a description of the requirement or of any method for implementing it, since it is assumed that optimization is familiar by now. The paper concentrates rather on misunderstandings of and achievements owed to optimization and explores some of their underlying causes, the intention being to draw lessons from past experience and to apply them to future developments in this area. The paper presents an outlook on some remaining policy issues that still pending solution as well as some suggestions on prioritization of implementation of optimization and on standardizing the optimization protection.

16544 (INIS-XN—149, pp 37-80) **Optimisation and decisions in radiological protection - A report of the work of an ICRP task group.** Webb, G.A.M. (National Radiological Protection Board Chilton (UK)). 1988. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW. (CONF-8803179—).

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

In 1984 the International Commission on Radiological Protection (ICRP) established a Task Group of Committee 4 to produce a report on methods for optimisation of protection other than cost-benefit analysis. As the work of the task group progressed it became clear that it would be more useful to produce a report on the entire field of application of optimisation, mainly to show how the various techniques including cost-benefit analysis could be applied appropriately to problems at different levels of complexity. This paper reports on the main ideas that have been developed by the task group. It must be emphasised that these ideas have not been endorsed by Committee 4 nor approved by the Commission so they can not yet be considered as recommendations.

16545 (INIS-XN—149, pp 87-112) **Integration of optimization in the regulatory process.** Cunningham, R.E.; Cool, D.A.; O'Connell, R.L. (US Nuclear Regulatory Commission, Washington, DC (USA)). 1988. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW. (CONF-8803179—).

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

The purpose of this paper is to describe how optimization fits in a complex regulatory regime aimed at protection of the public health and safety. The comments and observations about optimization in the regulatory process are based mainly on the authors' experience in a single agency, the US Nuclear Regulatory Commission (NRC). The NRC regulates a broad spectrum of nuclear activities ranging from nuclear power reactors and the nuclear fuel cycle to the use of radioisotopes in industry, research and medicine.

16546 (INIS-XN—149, pp 113-142) **Status of achievements reached in applying optimization of protection in design and normal operation of nuclear facilities.** Lochard, J.; Croft, J.R. (Centre d'Etude sur l'Evaluation de la Protection dans le domaine nucleaire, 92 - Fontenay-aux-Roses (France); National Radiological Protection Board, Leeds (UK)). 1988. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88705383/JAW. (CONF-8803179—).

From Meeting on the application of optimisation of protection in regulation and operational practices; Paris, France (14 Mar 1988).

The increased emphasis in recent years on the ALARA principle and its practical implementation has opened new perspectives in the organisation of radiological protection. This change could be characterised as a shift from an 'a posteriori' control, (i.e. demonstrating that dose limits had not been exceeded), towards an 'a priori' management or dose predictive approach. Undoubtedly in both operation and design conscious efforts are made to achieve ALARA. However, there are certainly differences in various organisations' perceptions of what this practically entails and there is scope for us all to learn. If the 'ALARA Procedure' remains only a tool used at the early stage of design or as an elegant means of justifying past choices, it will have missed its main objective which is to give more rational and coherent management of practical protection at both the design and operational stages. We feel that the integration of the structured approaches of the ALARA Procedure and the ALARA Audit, into radiation protection programmes provides the best way forwad. This would require ALARA studies moving from the province of the 'experts' to the 'practitioners'. This in turn will require us to provide them with the tools to do the job. The methodology is secure but the areas of dose data collection and the costing of detriment need to be addressed further. Similarly, there is perhaps a need for the 'experts' to develop further experience of using the multiattribute and multicriteria techniques for the higher level decisions.

16547 **(IPEN-PUB—183) Thyroid measurement method for monitoring laboratory workers exposed to I/sup 125/.** Ribela, M.T.C.P.; Araujo, E.A. de; Bartolini, P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Aug 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705542/JAW.

We describe here the standardization of a technique for the estimation of /sup 125/I in the thyroid gland of laboratory workers involved with /sup 125/I labelling techniques. It is based on a comparison with a standard curve obtained by placing in a thyroid neck phantom various calibrated standard sources of /sup 125/I. Its sensitivity was calculated around 0,8 - 1,7 nCi. The precision of our measurements was avaliated in a range of 1.35 - 310.5 nCi and the coefficient of variation obtained varied from 2,2% to 26,3%. The accuracy of our "in vivo" measurements was checked by analyzing the influence of the shape and the size of the thyroid in the neck phantom.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 15152, 15225, 15227, 15227, 15233, 15234, 15234, 15235, 15236, 15262, 15278, 15323, 15331, 15338, 15349, 15398, 15463, 15466, 15466, 15489, 15490, 15515, 15574, 15904, 16243, 16244, 16275, 16286, 16658, 16659, 16662, 16675, 16752

16548 **(CBPF-NF—034/88) Spin one Ising model with competing interactions on the Bethe lattice.** Coutinho, S.G.; Silva, C.R. da. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705400/JAW.

The phase diagram of the spin one Ising model with competing interactions between first and second nearest neighbors generations, single ion anisotropy and quadrupolar interactions is studied. Modulated phases, multiphase point and reentrances are observed and discussed. For high competing single ion anisotropy the paramagnetic phase reaches a finite region of the ground state.

16549 **(CBPF-NF—037/88) Surface magnetic order and effects of the nature of the interactions.** Tsallis, C.; Chame, A.M.N. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705402/JAW.

We discuss, within a real-space renormalization-group, interesting thermal effects (surface singularity at the bulk transition; Ising-Heisenberg crossover) concerning the free surface of a semi-infinite d=3 spin 1/2 anisotropic Heisenberg ferromagnet. Comparison with the Mermin-Wagner theorem and with experimental work is done.

16550 **(CBPF-NF—040/88) +- J D-vector spin glass phase diagram and critical behaviour.** Coutinho, S.; Lyra, M.L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 27p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705405/JAW.

The phase diagram and the correlation length exponents of the +- J D-Vector Spin-Glass model are studied in the framework of the real space mean field renormalization group method. The boundary between the spin-glass (SG) and the ferromagnetic (F) phases is obtained from the renormalization flow equations and shows a reentrant behaviour over the SG region. This re-entrance increases smoothly with the coordination number. Analytical expressions for the thermal and the correlation length exponents are calculated straight forwardly for all fixed points and figures are presented and compared with availables results from other methods and data.

16551 **(CBPF-NF—047/88) Rf power and nuclear magnetic relaxation in Gd Al/sub 2/.** Oliveira, I.S.; Guimaraes, A.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705410/JAW.

We have measured the /sup 27/Al and /sup 157/Gd nuclear magnetic relaxation times and their rf power dependence in GdAl/sub 2/ at 4.2 K. The relaxation times at the two peaks in the /sup 27/Al spectrum are different, confirming that the main contribution to the NMR signals comes from domain walls in the first peak (49 MHz) and from domains in the second peak (61 MHz).

16552 **(CEA-CONF—9442) Diffraction of an atomic helium beam.** Lapujoulade, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 5p. (In French). (CONF-8803169—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756646/JAW.

From Training meeting on spectroscopic methods for interfaces and surfaces analysis; Thiasis, France (21 Mar 1988).

The history, principles, and experimental set-up of the study of the diffraction of a helium beam by a crystal are recalled. The helium-surface interaction potential is explained. Surface study by helium diffraction; and the study of inelastic scattering: measurement of the scattering relation of surface phonons are considered.

16553 **(CEA-CONF—9575) Conformation of comb liquid crystal polymers by neutron small angle scattering.** Noirez, L.; Pepy, G. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1988. 16p. (CONF-880432—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756649/JAW.

From 8. general conference of the Condensed Matter Division, European Physical Society; Budapest, Hungary (6 Apr 1988).

A review is made of the direct information obtained by small angle neutron scattering about the anisotropy of the components parallel and perpendicular to the orienting magnetic field of the radius of gyration of comb like liquid crystal polymers. The behaviour of the conformation versus temperature is reported for several samples. Until now all samples show an oblate conformation in the smectic phase and probably the whole range of the nematic phase. The results are compared with the available theoretical predictions.

16554 **(CEA-tr—2254) Study of particle track formation in crystals.** Sigrist, A.; Balzer, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1988. 16p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756433/JAW.

Energy loss (dE/dξ MeVcm/sup 2//mg) for track formation in a dielectric is determined for mica, tourmaline, fused quartz, quartz crystal, lithium niobate and beryllia is determined. The value dE/dξ of a track detector can be estimated from thermal conductivity.

16555 (CONF-870155—, pp 1-11) **Observations of localised dielectric excitations, secondary events and ionisation damage by scanning transmission electron microscopy.** Howie, A. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

In the scanning transmission electron microscope (STEM) a high intensity {approximately}0.5nm diameter, probe of 100 keV electrons is formed. This can be positioned to collect energy loss spectra from surfaces, interfaces, small spheres or other particles at controlled values of impact parameter or can be scanned across the object (usually a thin film) to produce high resolution images formed from a variety of signals - small angle or large angle (Z contrast) elastic scattering, inelastic scattering (both valence and core losses), secondary electron emission and x-ray or optical photon emission. The high spatial resolution achievable in a variety of simple structures raises many unsolved theoretical problems concerning the generation, propagation and decay of excitations in inhomogeneous media. These range from quite well posed problems in the mathematical physics of dielectric excitation to problems of plasmon propagation and rather more exotic and less well understood problems of radiation damage. 15 refs., 4 figs.

16556 (CONF-870155—, pp 13-42) **Differential inelastic scattering cross sections for slow electrons in solids.** Tougaard, S. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

It is shown that a theoretical analysis of experimental electron energy spectra allows a determination of absolute inelastic electron scattering cross sections. Experimental examples are given, and the resulting cross sections are compared to calculations based on a dielectric response description of the solid-electron interaction. 28 figs.

16557 (CONF-870155—, pp 43-57) **Inelastic cross sections for swift charged particles in single element and compound materials.** Salvat, F.; Hayol, R.; Novoa, J.J.; Martinez, J.D. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

The local density approximation (LDA) seems to be adequate for protons at energies above 0.5 MeV. It slightly underestimates the stopping cross section for energies below 1 MeV. Although LDA results for electrons in solids agree well with experimental data, theoretical e/sup minus/-atom cross sections are greater than the experimental. This is probably a consequence of exchange effects ignored in the LDA. 4 figs., 6 tabs. (JF)

16558 (CONF-870155—, pp 59-67) **Calculation of electron-beam damage in organic materials.** Garcia-Molina, R. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Electron-beam induced damage (loss of structure if any, molecular alterations,...) has been experimentally detected in some hydrocarbons with a sharp threshold in its energy dependence. This sharp threshold and the shape of the damage curve as a function of the incident electron-beam energy correlate with the process of K-shell ionization of the carbon atoms. The qualitative description of the damage is thought to be through carbon K-shell ionization, after which the carbon atom becomes positively double charged via an Auger process, in such a manner that bond breakage can take place as a consequence of Coulomb repulsion. 5 refs., 3 figs.

16559 (CONF-870155—, pp 69-88) **STEM/EELS at interfaces.** Batson, P.E. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Intention - to obtain an analytical tool similar in use to XPS, UPS and EELS (Electron Energy Loss Spectroscopy), but appropriate for small volumes near buried interfaces. 22 figs.

16560 (CONF-870155—, pp 89-94) **μ-induced wakes.** Rivacoba, A. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

The direct interaction with the electrons is now repulsive and therefore does not lead to direct capture as in the case of a positive ion. The possibility of wake trapping, associated with regions of depletion of electrons in the induced charge density fluctuations, remains a valid one; such trapping, however, now occurs closer to the ion, since due to its negative charge the first depletion of electronic charge occurs in the region surrounding the ion (in the same region where there was a pile in the case of a positive ion). In this paper we explore the possibility of the existence of such bound states in the wake of a swift negative ion, and conclude that, for an accessible range of velocities binding exists and convoy electrons originating from wake bound states may be experimentally detected. 12 refs., 1 fig., 1 tab.

16561 (CONF-870155—, pp 95-105) **Energy loss in electron microscopy.** Bausells, J. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

In this work a new general approach to the problem of the interaction of electrons with solid surfaces is presented. It has practical utility in energy-loss problems in electron microscopy, but can also be useful in other problems involving electrons at surfaces, such as the definition of an optical potential in LEED and RHEED, or in the problem of image surface states. A many-body self-energy formalism is used in which any local dielectric response function $\epsilon(\omega)$ can be used. Some applications to spherical and planar targets in electron microscopy will be discussed, with emphasis in problems related to the scanning transmission electron microscope (STEM). In a STEM configuration, a well-focused 0.5 nm beam of swift electrons provides electron energy-loss spectra from selected local regions of the target. 19 refs., 7 figs.

16562 (CONF-870155—, pp 107-111) **Image potential states at surfaces.** Pendry, J.B. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Image states have been observed in a wide variety of contexts and papers given at this meeting by Neville Smith and Franz Himpsel give the state of the art on experimentation. In this paper I shall develop the theory of these states in the context of disordered insulators and show how they may play a central role in the generation of 1/f noise at the surfaces of these materials. First developed is the scattering theory approach to surface states. 2 refs.

16563 (CONF-870155—, pp 113-126) **Two-photon photoemission from image states.** Himpsel, F.J.; Giesen, K.; Hage, F.; Riess, H.J.; Steinmann, W. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Experimental techniques for the observation of image potential states are reviewed, i.e., inverse photoemission, two-photon photoemission and resonant second harmonic generation with the image state as final state. Presently, two-photon photoemission provides the best energy and momentum resolution for probing image states. It is possible to achieve high enough population densities to observe electron-electron interaction effects. An overview of experimental results is given and the prospects for observing two-dimensional electron gas phenomena are discussed. 6 refs., 10 figs.

16564 (CONF-870155—, pp 127-138) **Inverse photoemission process.** Smith, N.V. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This paper contains energy level figures, cross section ratios, and other information related to inverse photoemission. 8 figs. (JF)

16565 (CONF-870155—, pp 139-159) **Scanning tunneling microscopy.** Louis, E. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This paper covers surface topography, surface spectroscopy, and surface topography versus surface spectroscopy as related to scanning tunneling microscopy. 19 refs. (JF)

16566 (CONF-870155—, pp 169-197) **Barrier potential calculations at the metal-vacuum-metal interface.** de Andres, P.; Flores, F.; Echenique, P.M.; Ritchie, R.H. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This paper contains calculations of Barrier Potential at the metal-vacuum-metal interface and experimental results of the same. An electron-surface interaction potential is also approached using various methods. 14 figs. (JF)

16567 (CONF-870155—, pp 199-214) **The influence of the geometry of the electrodes in tunneling microscopy.** Laszlo, J.; Balazs, E. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

The influence of the geometry of the electrodes on the tunnel current has been taken under investigation. The rotational hyperboloid shaped tip as a cathode against a plane anode has been the model for obtaining dependence of the tunnel current on electrode separation, radius of curvature of the tip and bias voltage. Besides test runs a realistic metal-vacuum-metal system has been studied. 15 refs., 7 figs.

16568 (CONF-870155—, pp 265-315) **Synergistic effects in chemical etching of materials.** Auciello, O. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Chemical and radiation-enhanced gas-solid etching of materials that are important in microelectronics, fusion and space technologies, are compared and reviewed. The basic processes that drive spontaneous etching of several etchant-material combinations are similar: F/Si, H/Si and H/C can be cited as examples. On the other hand, many etchant-material systems appear to involve system-specific processes that should not be generalized: examples are the XeF_2/Si and Cl/Si systems. Experiments show that chemical etching is generally enhanced when the flux of thermalized active species to surfaces is accompanied by energetic particle or photon bombardment. In microelectronic materials etching, investigators have systematically studied etching product yield and product kinetic energy as a function of ion mass, ion energy and angle of incidence; data on temperature dependence of etching are more limited. By contrast, the temperature dependence of etching C and C-composites in fusion technology has been studied extensively, but there is a lack of data on ion mass and angle dependence, and on the kinetic energy of products. There appears to be no comparable data on ion-assisted etching of materials in typical space environments. These fundamental parameters are essential for formulating and testing models of ion-enhanced etching chemistry. The available data are discussed in terms of phenomenological models and calculations that have been developed. It is clear that further work will be required to provide a solid understanding of the phenomena discussed in this review. 86 refs., 16 figs.

16569 (CONF-870155—, pp 317-327) **Nitrogen molecular ion-plasma interactions in solids (1–3 a.u. velocity range).** Steuer, M.F. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Experiments with intermediate velocity nitrogen molecular ions passing through thin carbon foils, and early efforts to understand the unexpected diminishment of the average stopping power per atom relative to atomic ions having the same velocity, have provided insights into the ion-plasma interaction for ions which retain many of their bound-state electrons while moving in solids. Average stopping powers per atomic ion, for Nitrogen molecular ions having their internuclear axes aligned along the direction of motion, have been calculated as a function of internuclear separation in an electron gas. An extension of the Brandt-Kitagawa model was used to represent the moving charge distribution, and a low-velocity approximation to the Lindhard dielectric function was used to calculate its interaction with the electron gas. Results appear to be consistent with the experimentally observed diminishment of average stopping power per atom for nitrogen molecular ions and the hypothesis that increased screening of the nuclear charges occurs at small internuclear separations. 6 figs.

16570 (CONF-870155—, pp 385-398) **Interaction of slow ions with matter.** Echenique, P.M.; Ritchie, R.H.; Ashley, J.C.; Flores, F.; Guinea, F.; Gras-Marti, A.; Barberan, N.; Nieminen, R. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This paper contains figures, data and a brief summary of the theory and particular problems as related to the interaction of slow ions with matter. 7 figs., 1 tab. (JF)

16571 (CONF-870155—, pp 399-434) **Charge states of ions moving in metals.** Flores, F.; Guinea, F.; Echenique, P.M.; Ritchie, R.H.; Sols, F. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This document discusses the charge states of ions moving in metals. 27 figs. (JF)

16572 (CONF-870155—, pp 439-444) **Scattering of molecular ions at grazing incidence from metal surfaces.** Heiland, W.; Imke, U.; Schubert, S.; Snowdon, K.J. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Results of the studies on molecular ion scattering have been published previously or are in press. The most important theoretical result in the validity of the symmetry considerations in our case as proposed by Dum for electron-molecule interactions. This result is proven by the experiments using N_2^+ and O_2^+ molecular ions. The wavefunctions of the ionic and neutral states of these molecules are such that in case of O_2^+ only nonbonding states are filled by electron capture from the surface, whereas in case of nitrogen also the N_2 ground state is accessible. The experiments using H_2^+ and Al(110) show qualitative agreement with the theoretical predictions. The evaluation of the center of mass energy distribution of the dissociated H atoms is in qualitative agreement with the model which implies Franck-Condon-Transitions from vibrationally excited H_2^+ into the $b^3\ \Sigma/\text{sub}\ u/^+\ H + H$ states by resonant electron capture (dissociative attachment). The relative yield of H_2 and H after the scattering is of the expected order of magnitude if the elastic surface scattering is taken into account. A quantitative test of the theorical result is not possible at present, since the "surface rainbow" effect deflect a large number of dissociated particles into the detector. The estimates of this effect are not accurate enough. This is clear when considering the numbers involved. The symmetry conservation predicts at 300 eV primary energy an H_2/H ratio of for all particles and of 100:1 for a detector with a 1{degree} acceptance angle. The surface rainbow effect may change this ratio by a factor of 20 to 50 bringing the expected ratio into the range of the experimental result of abut 2:1. Details will be published later. 6 refs., 3 figs.

16573 (CONF-870155—, pp 445-453) **Energy-loss-skewness coefficients for 50 to 250 keV protons traversing thin solid films.** Eckardt, J.C.M.; Capuj, N.E.; Lantachner, G.H.; Arista, N.R. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

When a monenergetic ion beam tranverses a thin solid foil, the ions are slowed down and dispersed in energy. Therefore, to get information about the stopping processes, it is interesting to analyze not only the mean energy of the distribution, but also its shape, i.e. higher order moments, which allows also the obtention of knowledge about the stopping of those particles whose energy deviates from the mean. Here we present some preliminary results of experimental energy loss distribution widths and skewness coefficients together with calculations, for 50--250 keV protons traversing thin Al, Cu and Au foils. 1 ref., 6 figs.

16574 (CONF-870155—, pp 465-485) **Effective charge parametrization in Bethe-Bloch theory of stopping powers of solid targets for heavy ions.** Porter, L.E. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

A recent study by the author of effective charge parameterization of electronic stopping powers for heavy ions has indicated a necessity for two such parameters. The behavior of each of the selected parameters as a function of projectile atomic number (z) for a fixed target atomic number (Z) suggests structure, with a dominant maximum occurring near $z = 14$ and a lesser maximum appearing near $z = 26$ in the cases of C, Al, and Cu targets. This trend is not apparent for the case of Ag targets, however. The consequence of this structure on the effective charge is investigated. The results are related to those of previous studies of z-oscillations in the stopping power of a given target. Conjectural interpretation of parameter structure in terms of atomic shell configurations is advanced. 9 refs., 17 figs.

16575 (CONF-870155—, pp 555) **Low energy dynamics of charged particles at metal surfaces.** Guinea, F. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This abstract discusses the low energy dynamics of charged particles at metal surfaces.

16576 **(CONF-8809267—1) Motion of organic species occluded or sorbed within zeolites.** Newsam, J.M.; Silbernagel, B.G.; Melchior, M.T.; Brun, T.O.; Trouw, F. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89005866/JAW.

From 5. international meeting on inclusion phenomena and molecular recognition; Orange Beach, AL, USA (18 Sep 1988).

Containment of organic species within microporous materials such as zeolites influences their modes of molecular motion. This manifests itself in a range of ways, including a reduction in the volume that is readily accessible to the molecules by translation, constraints upon the molecular conformational space, restricted modes of molecular reorientation, or altered vibrational frequencies. The perspectives on certain of the motional properties of sorbates and of tetramethylammonium cations within zeolites provided by simple molecular modeling, neutron powder diffraction, ^{13}C and $^{2}H(D)$, and inelastic and quasielastic neutron scattering are outlined and illustrated by selected recent results. 56 refs., 5 figs.

16577 **(DOE/ER/13441—5) Interactions of molecules with surfaces: Progress report, 1 August 1986--31 January 1989.** Greene, E.F. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). Jan 1989. Contract FG02-85ER13441. 8p. (COO—4974-11). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006465/JAW.

The work supported by the grant during the last three-year period has been mainly on three continuing projects. These are: The use of the diffraction of He atoms to follow phase changes on the surfaces of Si and Ge crystals; The measurement of temperatures of surfaces receiving impacts from a beam of molecules; and the Measurement of the efficiencies with which alkali atoms striking a surface are ionized as this varies with the temperature of the surface and the kinetic energy of the incoming atoms.

16578 **(DOE/ER/45236—T2) Defect mediated melting in colloidal monolayers.** Armstrong, A.J. (Colorado Univ., Boulder (USA). Dept. of Physics). 1988. Contract FG02-86ER45236. 181p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005908/JAW.

Polystyrene microspheres placed carefully on the surface of water form ordered structures ranging from weakly interacting gasses to defect-sparse two dimensional solids. These systems are microscopically observable and are ideal for observing defect evolution as the systems melt. Using microscopy in combination with image processing techniques the equation of state, defect structures, and the translational and orientational correlation functions are found as the systems melt (solidify) when isothermally expanded (compressed). The data are analyzed with the specific intent of examining the validity of the Kosterlitz-Thouless-Halperin-Nelson-Young (KTHNY) theory of two dimensional defect mediated melting. In this theory melting occurs in a two step continuous process governed by the separation of bound topological defects. The solid first loses its translational order by the unbinding of bound dislocation pairs. This results in an orientationally ordered intermediate phase called the Hexatic that evolves to a true liquid by disclination unbinding. Two particle sizes, 2.88 μm dia. and 1.01 μm dia., were examined in this work. The 2.88 μm system showed evidence of defect mediated melting and of an intermediate hexatic phase, in partial accord with the KTHNY theory. However, the loss of orientational order was mediated by the formation of grain boundaries and the predicted disclination unbinding transition was not observed. Melting in the 1.01 μm system appeared to proceed by a weak first order transition. It is suggested that the difference between the two systems is attributable to the core energy required to create bound dislocation pairs. From observations on the number

and frequency of occurrence of virtual dislocation pairs in these systems, an additional mechanism for dislocation unbinding is postulated. 72 refs., 61 figs., 2 tabs.

16579 **(FEI—1911) Combinatorial method of calculation of multiparticle excitation spectrum in independent-particle model.** Bardychev, D.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705441/JAW.

Combinatorial method of multiparticle excitation spectrum acquisition, based on the application of generating functions means is considered. Its applications to Woods-Saxon spherically-symmetrical potential with the parameters, characteristic for nuclei within iron field, are considered and comparison with experimental data is carried out. 12 refs.; 4 figs.

16580 (IA—1440, pp 159-160) **Perturbed angular correlation studies of hafnium hydrides.** Berant, Z.; Mintz, M.H.; Wolf, A. (Israel Atomic Energy Commission, Tei Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16581 (IA—1440, pp 114-115) **Anomalous behavior of the Ni bonding strength in some LaNi/sub 5-x/Al/sub x/H/sub y/ compounds.** Jacob, I.; Moreh, R.; Shahal, O.; Wolf, A.; Zamir, G. (Ben-Gurion Univ. of the Negev, Beersheba (Israel); Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16582 (IA—1440, pp 77-78) **Interaction of helium-hydrogen plasmas with metal and ceramic surfaces: Pt.1. Electron density in the plasma layer near the surface.** Avni, R.; Carmi, U.; Inspektor, A.; Nickel, H.; Linke, J.; Koizlik, K. (Israel Atomic Energy Commission, Tel Aviv; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16583 (IA—1440, pp 78-79) **Interaction of helium-hydrogen plasmas with metal and ceramic surfaces: Pt.2. Surface damage in inconel, boron nitride, graphite and silicon carbides.** Carmi, U.; Inspektor, A.; Raveh, A.; Avni, R.; Koizlik, K.; Linke, J.; Nickel, H. (Israel Atomic Energy Commission, Tel Aviv; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16584 **(IAE—4567/6) To electronic process theory at slow multicharged ion collisions with metal surface.** Chibisov, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 12p. (In Russian). NTIG (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705442/JAW.

The electronic processes occurring in the collisions of slow multicharged ions with the surface of a metal have been classified, with its polarization considered in terms of an image charge. The polarization of the metal affects essentially the probabilities of some these processes. The asymptotics of the displacement of the ion electronic levels due to the interaction with the image charge in the metal has been studied and it has been shown that these levels are ejected to the continuous spectrum. A great amount of slow emission electrons observed experimentally can be explained by the ejection of the levels. The capture of an electron by an ion at the metal surfaces takes place only through the two-electron Auger-process. A new process of inelastic tunnelling or decay due to release of the polarization energy has been observed for the ionization of atomic particles at the surface of the metal. 19 refs.; 2 figs.

16585 **(IAE—4596/1) Spectroscopy of channeld particle channeling interaction with crystals.** Tulupov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705444/JAW.

Theoretical and experimental investigations of channeling radiation spectra of meV electrons and positron are considered. Possibilities of extraction information about crystals from channeling radiation spectra are studied. 74 refs.

16586 **(IAE—4609/1) Orientation effects in interactions of relativistic charged particles with crystals. Pt. 1.** Goloviznin, V.V.; Laskin, N.V.; Tulupov, A.V.; Fomin, S.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705446/JAW.

The review of theoretical results on relativistic charged particles interaction with aligned crystals is presented. The principles of describing of relativistic electrons and positrons motion and radiation in wide range and radiated quanta frequency, particle energy and angle between its velocity and the main crystallographic directions are included. 51 refs.; 7 figs.; 4 tabs.

16587 **(IAE—4610/1) Orientation effects in interactions of relativistic charged particles with crystals. Pt. 2.** Goloviznin, V.V.; Laskin, N.V.; Tulupov, A.V.; Fomin, S.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705447/JAW.

The review of theoretical results on relativistic charged particles interaction with aligned crystals is presented. The principles of describing of relativistic electrons and positrons motion and radiation in wide range of radiated quanta frequency, particle energy and angle between its velocity and the main crystallographic directions are included. 33 refs.; 22 figs.

16588 **(IAE—4612/11) Orientation dependence of characteristic X radiation yield during relativistic electron transit through crystal.** Ognev, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705448/JAW.

Orientational dependences of inelastic scattering of relativistic channeled electrons in crystals were investigated. Within the Born approximation the expression for inelastic scattering cross section and its approximation throught integral of close scattering with thermalised atoms were obtained. Orientational dependences are calculated for characteristic X-ray radiation under collimated 20 MeV electron beam transmission through silicon single crystal with account for X-ray absorption in matter. The new method was suggested for determination of electron dechanneling length with orientational dependences for characteristic X-ray radiation data. 13 refs.; 3 figs.

16589 **(IAE—4628/9) Nuclear spin wave relaxation in antiferromagnets.** Andrienko, A.V.; Ozhogin, V.I.; Safonov, V.L.; Yakubovskij, A.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705450/JAW.

We consider up to date experimental and theoretical investigations for nuclear spin waves studying in weak anisotropy antiferromagnets at helium temperatures. The main models used for the experimental data interpretation are described and their advantages and disadvantages are analyzed. Some nuclear problems are discussed. 72 refs.; 25 figs.; 2 tabs.

16590 (IAE—4649/9) **Intermediate valence and Kondo effect influence on crystal electric field: neutron spectroscopy of intermetallic rare earth compounds.** Alekseev, P.A.; Lazukov, V.N.; Sadikov, I.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705452/JAW.

The results are presented of studying the intermediate valence systems Pr/sub x/(Ce/sub -y/Y/sub y/)/sub 1-x/Ni/sub 5/ and the Kondo systems CeAl/sub 3/ and CeCu/sub 5/ with paramagnetic (Pr) and magnetoactive (Nd) impurities. The intermediate valence state in the CeNi/sub 5/-based compounds leads to screening of the crystal field potential; effects connected with f-electron correlation are observed. InCeAl/sub 3/ strong s-f interaction manifests itself in increase in the crystal field splitting of the J-multiplet and essential broadening of the crystal field levels. Appearance of the short-range magnetic order in the Kondo system CeCu/sub 5/ has been found. 10 refs.; 11 figs.

16591 (INIS-mf—11348, pp 135) **Behavior of polymerized liquid crystal phases studied by positron annihilation.** Lopez, R.; Millan, S.; Alvarez, J.C.; Fucugauchi, L.A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16592 (INIS-mf—11348, pp 137) **Effect of the hydrocarbon chain length in a surfactant on the structure of liquid crystals.** Millan, S.; Lopez, R.; Fucugauchi, L.A. (Instituto Nacional de Investigaciones Nucleares, Mexico City). Jul 1988. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88705380/JAW. (CONF-8807148—).

From 7. Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry; Zacatecas, Mexico (25 Jul 1988).

16593 (INIS-SU—68, pp 518) **Study of iron atom distribution in SrFe/sub 2/ fluorite crystal by NGR method.** Sattarov, S.A.; Muminov, A.I.; Yuldashev, U.Yu.; Khalilov, O.K.; Bogdanov, R.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16594 (INIS-SU—68, pp 519) **H/sub n/(T) anomaly temperature dependence of Fe/sup 2+/ impurity ions in SrF/sub 2/.** Muminov, A.I.; Yuldashev, U.Yu.; Parsakhanov, A.G.; Sattarov, S.A.; Bogdanov, R.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16595 (INIS-SU—68, pp 520) **NGR investigation of phase formation processes after carbon implantation in steel-45.** Zhetbaev, A.K.; Ozernoj, A.N.; Savost'yanov, Yu.G.; Ryzhikh, V.Yu.; Sigle, V.O.; Nusupov, K.Kh. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16596 (INIS-SU—68, pp 523) **NGR-investigation of Ni/sub 3/(Fe/sub 1-x/Mn/sub x/) system alloy ordering.** Zhantikin, T.M.; Zhetbaev, A.K.; Serikbaeva, Z.T. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16597 (INIS-SU—68, pp 527) **Study of difference effects on chemical composition and atom distribution in iron and copper base alloys by NGR method.** Binnatov, K.G.; Rodionov, Yu.L.; Ali-Zade, I.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16598 (INIS-SU—68, pp 565) **Investigation of V/sub 2/(Hf/sub 0.51/Nb/sub 0.49/) compounds by perturbed angular correlation method.** Georgiev, A.; Ivanov, S.; Tumbev, G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16599 (INIS-SU—68, pp 606) **Use of gamma resonance spectroscopy in studies on interaction of pulsed visible radiation with a substance.** Babikova, Yu.F.; Petrikin, Yu.V.; Ali-Zade, I.I.; Kabanova, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16600 (INIS-SU—68, pp 607) **Simple representation of Moessbauer spectrum shape taking into account the effective thickness of an absorber.** Babikova, Yu.F.; Bakanova, E.S.; Kolpakov, N.S.; Nilov, K.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16601 (INIS-SU—68, pp 608) **Line shape in Moessbauer spectrum of iron characteristic radiation.** Babikova, Yu.F.; Bakanova, E.S.; Kolpakov, N.S.; Nilov, K.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16602 (INIS-SU—68, pp 521) **Radiation-induced damage RGR-spectroscopy in Ni/sub 3/Mn.** Akulov, N.I.; Vereshchak, M.F.; Zhantikin, T.M.; Zhetbaev, A.K.; Satpaev, K.K. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16603 (INIS-SU—68, pp 530) **Damaging power anomaly dependence from on Z ion at interaction with Ge monocrystals.** Karamyan, S.A.; Rykhlyuk, A.V.; Bugrov, V.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16604 (INIS-SU—68, pp 550) **Description of electron beam axial channeling based on space charge parameter.** Kaurov, V.N.; Baev, G.P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16605 (INIS-SU—68, pp 552) **On efficiency of ionizing radiation effect on crystals with superlattice.** Koroteev, Yu.M.; Filipenko, L.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16606 (INIS-SU—68, pp 555) **Positron annihilation in electron irradiated indium phosphide.** Litovchenko, P.G.; Likhtorovich, S.P.; Makarenko, V.G. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16607 (INIS-SU—68, pp 557) **On some features of target sputtering by ions in nuclear-physical experiments.** Baranov, I.A.; Nikolaev, V.A.; Obnorskij, V.V.; Tsepelevich, S.O. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16608 (INIS-SU—68, pp 572) **Effect of gamma and X-radiation on SiO and SiO/sub 2/ film infrared spectra.** Evseev, I.I.; Gitlin, V.R.; Kadmenskij, S.G.; Levin, M.N.; Ostroukhov, S.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16609 (INIS-SU—68, pp 575) **Effect of X- and gamma radiation on ferroelectric unipolarity.** Milovidova, S.D.; Evseev, I.I.; Vavresyuk, I.V.; Sidorkin, A.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16610 **(KURRI-TR—302) Proceedings of the specialist research meetings on semiconductors with research reactors.** Kawakubo, Tetsuya (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1988. 74p. (JA;EN). (CONF-8707203—; CONF-8801128—). NTIS (US Sales Only), PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003365/JAW.

From Specialist research meeting on semiconductors with research reactors; Kyoto, Japan (27 Jul 1987).

This report is a proceeding of the specialist meeting on semiconductors with research reactors held at the Research Reactor Institute, Kyoto University on July 27 in 1987 and January 18 in 1988. The first meeting was held with the interest focused on impurity analysis of semiconductors with the method of activation analysis using nuclear reactors and accelerators, secondary ion mass spectroscopy, infrared absorption and atomic absorption analysis. In the second meeting, the topics on application of ion beam and neutrons on semiconductors was talked on put emphasis on the effect of its energy dependence. In addition, urgent special speeches and animated discussions concerning high temperature superconductors of a recent topic were given.

16611 **(LA—11488-MS) SESAME equation of state number 7386, fused quartz.** Boettger, J.C. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006367/JAW.

A new equation of state (EOS) for fused (SiO_2) has been constructed for the SESAME library as material number 7386. This new EOS provides a substantially better representation of the principal Hugoniot than has been achieved in previous EOS's for fused quartz included in the SESAME library. 12 refs., 1 fig.

16612 **(LA-UR—88-4278) Pulsed laser effects phenomenology.** Dingus, R.S.; Goldman, S.R.; Kirkpatrick, R.C.; Montierth, L.M.; Stover, E.K. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-890145—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005466/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

A comprehensive overview of the phenomenology associated with the interaction of intense laser beams with matter is presented. The beam is assumed to be incident on a solid or liquid target located within a transport medium. The discussion is first categorized by the type of this medium; namely, vacuum, gas, liquid, solid or particulate. Then the dependence of the interaction is further classified by the laser flux, pulselength, wavelength and the target properties. The various classes of behavior are discussed along with the conditions for their occurrence. Classes discussed include: slow bulk heating, transparent vapor from the target surface, secondary energy transport to the ablation surface, laser absorption at the critical surface, shock induced blowoff, photoelectric cross section dependence on temperature and density, laser supported combustion and detonation, contained vaporization and Mie scattering. 21 refs., 2 figs.

16613 **(LBL—26300) Surface structures determined using electron diffraction.** Terminello, L.J. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 153p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006669/JAW.

The surface structures of c(2 {times} 2)S/Cr(001) and (1 {times} 1)PH/sub x//Ge(111) were determined using angle resolved photoemission extended fine structure (ARPEFS). For the chromium study, the S-Cr(1) layer separation was shown to be 1.17 {angstrom} with a fourfold hollow adsorption site, and an 8% contraction of the first-to-second layer Cr separation was measured with 0.02 {angstrom} precision. Structural information was obtained from multiple-scattering, spherical-wave(MSSW) analysis out to a 15 {angstrom} path-length difference and demonstrated the near-surface sensitivity of ARPEFS. The study of PH/sub x// Ge(111) revealed an unanticipated adsorption site of a phosphine molecular fragment. An atop site was observed which had the P atom tilting 16{degree} from normal and situated 2.26 {angstrom} above the surface. Each adsorption system contributed to the refinement of the ARPEFS technique by extending the depth to which ARPEFS can recover structural information, and by uncovering lateral displacements of adsorbates from high symmetry sites. The surface electron-energy-loss fine structure (SEELFS) technique was also investigated using Cu M/sub 2,3/ extended fine structure. This work confirmed a 0.2 {angstrom} error in determining interatomic distances. Inaccurate central atom phase shifts have been blamed for this anomaly, and in this work an attempt was made to calculate better phase shifts based on a more rigorous description of the central atom potential. The results were incomplete, but did indicate that a time-dependent formulation of the central-atom potential would be more appropriate. A new spectrometer capable of measuring multiple, angle-resolved photoemission spectra is described. The paraboloidal mirror analyzer was developed to efficiently measure multiple ARPEFS spectra from the same sample. The performance of this analyzer, which includes its angle- and energy-resolving capabilities, was demonstrated. 108 refs., 45 figs., 6 tabs.

16614 **(RAL—88-088) Adaptation of methods in multilayer optics for the calculation of specular neutron reflection.** Penfold, J. (Rutherford Appleton Lab., Chilton (UK)). Oct 1988. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705588/JAW.

The adaptation of standard methods in multilayer optics to the calculation of specular neutron reflection is described. Their application is illustrated with examples which include a glass optical flat and a deuterated Langmuir-Blodgett film.

16615 **(UCRL—100182) Interface tribology via nonequilibrium molecular dynamics.** Hoover, W.G.; Hoover, C.G.; Stowers, F.; Siekhaus, W.J. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 9p. (CONF-881155—41). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006210/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

By borrowing ideas from control theory, Nonequilibrium Molecular Dynamics incorporates temperature, stress, and heat flux directly into atomistic, time-reversible, deterministic equations of motion. We are applying this technique to studies of surface indentation, surface cutting, friction, ablation, and condensation. Here we describe simulations of the indentation and cutting processes using two-dimensional crystals composed of a few thousand particles. 12 refs., 6 figs.

16616 **(X-EP-LPMCGB-RA—1985) Annual report of the Laboratory for Condensed Matter Physics, and the Biophysics Group.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 25p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756712/JAW.

Research on photoemission and photoluminescence in quantum wells; photoemission assisted by electric fields; the electrochemistry of the semiconductor-electrolyte interface; MESFET's; fractal physics; amorphous silicon; superionic and mixed conductors; solids chemistry and NMR; internal motion of nucleic acids; cardiophysiology; imaging of microscopic internal motions; and Ap4A metabolism is presented.

16617 **(X-EP-LPMCGB-RA—1986) Annual report of the Laboratory of Condensed Matter Physics, and the Biophysics Group, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756713/JAW.

Research on photoemission and photoluminescence in quantum wells; photoemission assisted by electric fields; the electrochemistry of the semiconductor-electrolyte interface; transport properties of MESFET's; fractal physics; amorphous silicon; superionic and mixed conductors; solids chemistry and NMR; internal motion of nucleic acids; cardiophysiology; imaging of microscopic internal motions; and Ap4A metabolism is presented.

16618 (ZfK—584, pp 51) **Minority carrier lifetime improvement of high resistivity NTD-silicon and its application for counting detectors.** Bischoff, L. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16619 (ZfK—584, pp 52) **Two-step-annealing of high resistivity NTD-silicon.** Bischoff, L. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16620 (ZfK—584, pp 61) **Characterization of plasma enhanced chemical vapor deposited nitride layers.** Bauer, C.; Grambole, D.; Heiser, C.; Herrmann, F.; Rudolph, W. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16621 (ZfK—584, pp 62) **Boron depth profiling by the / sup 11/B(d, α/sub 0/)/sup 9/Be reaction.** Rudolph, W.; Bauer, C.; Heiser, C.; Urwank, P. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16622 (ZfK—584, pp 66) **Magnetic form factor of iron in amorphous Fe/sub 75/B/sub 25/.** Matz, W. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16623 (ZfK—584, pp 71) **Small-angle neutron scattering on hydrating cement paste.** Eichhorn, F.; Haeussler, F.; Miehe, U. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Technische Hochschule, Leipzig (German Democratic Republic). Sektion Naturwissenschaften). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16624 (ZfK—584, pp 80) **Structure dependence of quadrupole coupling constants in A/sup II/B/sup IV/C/sub 2// sup V/ chalcopyrite compounds.** Unterricker, S. (Bergakademie, Freiberg (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16625 (ZfK—584, pp 81) **Moessbauer study of Fe/sup 2+/ - Fe/sup 3+/ ordering in natural chromites.** Pietzsch, C. (Bergakademie, Freiberg (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16626 (ZfK—584, pp 48) **Diffusion enhancement and electrical activation during rapid isothermal annealing (RIA) of band As implanted Si.** Koegler, R.; Wieser, E. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16627 (ZfK—584, pp 49) **Electrical activation of Si-implanted GaAs by short-time annealing.** Panknin, D.; Doering, C.; Hueller, J.; Weise, C.; Wieser, E. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16628 (ZfK—584, pp 73) **Investigation of epitaxial (Ca,Sr)F/sub 2//GaAs heterostructures by Rutherford backscattering/channeling technique.** Flagmeyer, R.; Schumann, B. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik; Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Chemie). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16629 (ZfK—584, pp 74) **Microhardness of proton bombarded GaP single crystals.** Ascheron, C.; Neumann, H.; Dlubek, G.; Krause, R. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik; Martin-Luther-Universitaet Halle-Wittenberg, Halle (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16630 (ZfK—584, pp 75) **Hydrogen depth profiling in implanted GaP using elastic recoil detection.** Lehmann, D.; Ascheron, C. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16631 (ZfK—584, pp 76) **Depth resolution in differential hall-effect measurements for shallow implantation profiles.** Lukasch, B. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16632 (ZfK—584, pp 79) **Deep levels in n-Si caused by low energy ion implantation.** Bollmann, J.; Klose, H.A.; Mertens, A. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16633 (ZfK—584, pp 67) **Methodical investigations via texture of rock salt.** Betzl, M.; Voitus, W.; Ertel, A. Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16634 (ZfK—584, pp 68) **Neutronographic texture investigations of Halit.** Betzl, M.; Voitus, W.; Ertel, A.; Bankwitz, P.; Kaempf, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Chemie; Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Physik der Erde). Apr 1986. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE89780007/JAW.

In Annual report 1985 on nuclear physics activities and applications.

16635 **Electron stimulated desorption of oxygen from, and subsequent type conversion of, thin-film p-$CuInSe_2$.** Matson, R.J.; Kazmerski, L.L.; Noufi, R.; Cahen, D. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **7**: No. 2, 230-233(Mar 1989).

There are seemingly conflicting results from two sets of investigations in the literature concerning the electron stimulated desorption of oxygen incorporated into thin-film p-$CuInSe_2$ This has a direct bearing on the model for the role of oxygen in the important postdeposition oxygen treatment of CdS/$CuInSe_2$ solar cells, proposed in one of the published reports. By comparing the specific beam parameters of the scanning electron microscope (SEM)/ electron beam induced current (EBIC) versus scanning Auger microprobe (SAM) based studies and calculating charge density for the two cases, the SAM experiments are seen to support, rather than contradict, the results of the SEM/EBIC experiments. The evidence tying the addition and deletion of oxygen to changes in the electrical properties of the $CuInSe_2$ are then discussed.

16636 **Divergences in the force-balance theory of resistivity.** Fishman, R.S.; Mahan, G.D. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 2990-2993(15 Feb 1989).

By resumming over two sets of divergent terms, we show that the impurity resistivity calculated with the force-balance method can be reconciled with the usual result of the Boltzmann equation. Since this calculation is performed in the presence of a heat bath of phonons, we find that to first order in the electric field the "isothermal" and "adiabatic" resistivities are the same. The presence of divergences severely limits the applications of the force-balance method.

16637 **Adiabatic and isothermal resistivities.** Fishman, R.S. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 2994-3004(15 Feb 1989).

The force-balance method is used to calculate the isothermal resistivity to first order in the electric field. To lowest order in the impurity potential, the isothermal resistivity disagrees with the adiabatic results of the Kubo formula and the Boltzmann equation. However, an expansion of the isothermal resistivity in powers of the impurity potential is divergent, with two sets of divergent terms. The first set arises from the density matrix of the relative electron-phonon system. The second set arises from the explicit dependence of the density matrix on the electric field, which was ignored by force-balance calculations. These divergent contributions are calculated inductively, by applying a recursion relation for the Green's functions. Using the $\lambda^2 t \to \infty$ limit of van Hove, I show that the resummation of these divergent terms yields the same result for the resistivity as the adiabatic calculations, in direct analogy with the work of Argyres and Sigel, and Huberman and Chester.

16638 **Structural phase transitions with little phonon softening and first-order character.** Krumhansl, J.A.; Gooding, R.J. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York, 14853-2501). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3047-3053(15 Feb 1989).

We review a number of features of diffusionless structural transformations in materials where phonon dispersion or elastic constants are highly anisotropic and have anomalously low values in a few directions. Though those may change with temperature, they neither soften significantly nor become harmonically unstable at a transition. Standard soft-mode theory is not applicable. Instead, a generic first-order Landau-model free energy describes most of the features found experimentally, including limited phonon softening and precursor fluctuations (e.g., "central peak"). The microscopic basis of such models is demonstrated using anharmonic many-body phonon theory. The ideas are illustrated for ω phase transitions in zirconium.

16639 **Nonlinear refractive index of optical crystals.** Adair, R.; Chase, L.L.; Payne, S.A. (Lawrence Livermore National Laboratory, University of California, P.O. Box 5508, Livermore, California 94550). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 5, 3337-3350(15 Feb 1989).

The nonlinear refractive indices (n_2) of a large number of optical crystals have been measured at a wavelength near one micrometer with use of nearly degenerate three-wave mixing. The measurements are compared with the predictions of an empirical formula derived by Boling, Glass, and Owyoung. This formula, which relates n_2 to the linear refractive index and its dispersion, is shown to be accurate to within about 30% for materials with nonlinear indices ranging over 3 orders of magnitude. Measurements for a number of binary oxide and fluoride crystals have been analyzed under the assumption that the hyperpolarizability of the anion is much larger than that of the cation. It is found that the hyperpolarizability of oxygen varies by a factor of 10, and that of fluorine varies by a factor of 7, depending on the size of the coordinating cation. This behavior is similar to that of the linear polarizability, although the hyperpolarizability is much more sensitive than the linear polarizability to the identity of the cation. The measured halide ion hyperpolarizabilities for several alkali-halide crystals are in reasonable agreement with recent self-consistent calculations. A semiempirical model was proposed by Wilson and Curtis to account for the dependence of the linear anionic polarizability on the radius of the cation. This model also accounts quite well for the variation of the hyperpolarizability of both fluorine and oxygen, except for cation partners that have filled or unfilled d-electron shells. The nonlinear indices of a number of complex oxides (i.e., those with more than one cation) have been calculated from the partial hyperpolarizabilities deduced from the data for the binary oxides. The calculated and measured values of n_2 agree to within an average error of 13%.

16640 Growth dynamics of chemical vapor deposition. Bales, G.S.; Redfield, A.C.; Zangwill, A. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332-0430). *Physical Review Letters;* **62**: No. 7, 776-779(13 Feb 1989).

The morphological growth dynamics of chemical vapor deposition are studied with a model that takes account of both diffusive transport in the bulk and the kinetics of surface reactions. For the case of a fixed flux of reactant species far from the surface, we study numerically the crossover from diffusion-limited growth to surface kinetic-limited growth. In the latter case, one can qualitatively account for the morphology at early and intermediate times by use of a nonlinear growth model which takes explicit account of the destabilizing influence of the bulk phase diffusion field.

16641 Order parameters for reconstructive phase transitions. Horovitz, B.; Gooding, R.J.; Krumhansl, J.A. (Laboratory of Atomic and Solid State physics, Cornell University, Ithaca, New York 14853-2501). *Physical Review Letters;* **62**: No. 7, 843-843(13 Feb 1989).

A Comment on the Letter by V. P. Dmitriev et al., Phys. Rev. Lett. 60, 1958 (1988).

16642 Finite-size effects in Heisenberg antiferromagnets. Neuberger, H.; Ziman, T. (Department of Physics). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2608-2618(1 Feb 1989).

A system which exhibits antiferromagnetic order in the thermodynamic limit will, generically, have a symmetric ground state when the volume is finite. In this case the leading size dependence of various observables is controlled by soft magnons. The precise form of the finite-size corrections is worked out, and it is claimed that the expressions so obtained will be useful for the analysis of results obtained by Monte Carlo simulations or by exact diagonalization.

16643 Determination of effective-pair interactions in random alloys by configurational averaging. Dreysse, H.; Berera, A.; Wille, L.T.; de Fontaine, D. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2442-2452(1 Feb 1989).

A real-space method is presented for calculating effective-pair interactions (EPI's) in substitutionally disordered alloys, starting from electronic structure information for the constituting elements. The EPI's are obtained by averaging over a small number of randomly generated configurations. The electronic structure is calculated by tridiagonalizing a tight-binding Hamiltonian using the recursion method. Convergence, both as a function of the number of configurations and the number of recursion levels, is rapid, and the results compare very well with other calculations. The advantage of the present scheme is that deviations from lattice periodicity can be taken into account in a completely straightforward way. The EPI are essential ingredients in statistical methods for determining alloy phase diagrams.

16644 Role of noise in the initial stage of solidification instability. Qian, X.W.; Chou, H.; Muschol, M.; Cummins, H.Z. (Department of Physics, City College of the City University of New York, New York, New York 10031). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2529-2531(1 Feb 1989).

Evolution of the morphological instability at the initially flat interface of a nonfaceting crystal growing freely into its pure melt has been studied by a computer simulation. A stochastic differential equation for the spatial Fourier components of the interface was formed by adding Gaussian random-noise terms representing spontaneous temperature fluctuations to the deterministic Mullins-Sekerka result of linear stability analysis. The results of the simulation qualitatively reproduce recent experiments in succinonitrile in which the spatial Fourier spectrum was found to be extremely noisy. The noise level required in the simulation was found to agree qualitatively with a rough estimate of temperature-fluctuation effects.

16645 Existence of Anderson localization of classical waves in a random two-component medium. Soukoulis, C.M.; Economou, E.N.; Grest, G.S.; Cohen, M.H. (Corporate Research Science Laboratory, Exxon Research and Engineering Company, Annandale, New Jersey 08801). *Physical Review Letters;* **62**: No. 5, 575-578(30 Jan 1989).

An exact mapping of the classical wave problem to that of electronic motion is utilized together with extensive numerical results to examine the question of the existence of genuine localization (i.e., one occurring when both components have real positive dielectric constants) of classical waves in random binary alloys A/sub 1-//sub x/B/sub x/. We find that scalar waves do exhibit localization. We have also developed a coherent potential approximation which for $x<0.2$ gives results not that much different from the numerical ones. This result can be easily generalized to electromagnetic fields as well.

16646 Complex classical and quantum scattering dynamics and the quantum Hall effect. Trugman, S.A. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **62**: No. 5, 579-582(30 Jan 1989).

The effect of a magnetic field on potential scattering is investigated microscopically. Analytic, exact renormalization-group, and numerical solutions show that the classical scattering dynamics of a charged particle is extremely complex. In one case, the dynamics is described by a discontinuous one-dimensional Hamiltonian map. Preliminary results indicate complex quantum dynamics as well. Consequences include an explanation of the observed breakdown of the quantum Hall effect at large currents and possible 1/f noise.

16647 Dimensional reduction and universal $f(\alpha)$ in magnetic chains. Gyoergyi, G.; Satija, I.I. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). *Physical Review Letters;* **62**: No. 4, 446-449(23 Jan 1989).

We study both multivalued discrete and continuum spin chains in a binary random field. The discrete spin model with N values is mapped to a (N-1)-dimensional dynamical system. The system shows a drastic dimensional reduction with the important consequence that the local magnetization is a fractal. For small field, for the Ising and the continuum spin-O(n) chains, the multifractal properties of the magnetization can be described by a universal $f(\alpha)$ curve.

16648 Dodecagonal order in a two-dimensional Lennard-Jones system. Leung, P.W.; Henley, C.L.; Chester, G.V. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 446-458(1 Jan 1989).

We investigate a two-dimensional Lennard-Jones mixture with the interaction parameters chosen so as to favor configurations where the large atoms form squares and equilateral triangles. Many such configurations are possible which by our choice of interactions are nearly degenerate in energy. It is hypothesized that a thermal equilibrium state with 12-fold orientational order exists. Several Monte Carlo simulations were performed to cool the system to a temperature approaching zero. The ordering process was studied by following the evolution of the configurations with temperature. The onset of ordering seemed to be very diffuse in space rather than nucleated at a point. The resulting configurations consist of squares and triangles, except for a few dislocations, and thus have perfect orientational order. We also characterized the deviation from ideal quasiperiodicity in terms of the "phason strain"; this was analyzed both by fitting a linear relation between the physical space coordinates of the atoms and the corresponding "perpendicular space" coordinates, and also by calculating the diffraction peaks. The latter are shifted and broadened, relative to an ideal 12-fold diffraction pattern, as in real quasicrystals.

16649 Gorsky-Bragg-Williams approach to the study of long-period superlattice phases in binary alloys. Ceder, G.; De Graef, M.; Delaey, L.; Kulik, J.; de Fontaine, D. (Department of Metallurgy and Materials Engineering, Catholic University Leuven, De Croylaan 2, B-3030 Heverlee, Belgium). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 381-385(1 Jan 1989).

The influence of the shape of the reciprocal-space potential on the relative stability of long-period superlattice (LPS) phases in binary alloys is discussed in a Gorsky-Bragg-Williams approximation. First, for a certain class of LPS phases, the set of pair interaction parameters is reduced to a smaller set of parameters which characterize only the essential aspects of the reciprocal-space potential. Minimization of the free energy for different LPS phases is then used to extract some general tendencies, such as the change of wave vector towards the potential minimum (with increasing temperature) and the increasing stability of complex phases with deepening of the potential minimum.

16650 Dynamical correlations from mobile vortices in two-dimensional easy-plane ferromagnets. Mertens, F.G.; Bishop, A.R.; Wysin, G.M.; Kawabata, C. (Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 591-602(1 Jan 1989).

Assuming an ideal gas of unbound vortices above the Kosterlitz-Thouless transition temperature, we calculate the dynamic form factors for both the in-plane and out-of-plane correlations. In both cases central peaks are predicted which are, however, produced by quite different mechanisms, depending on whether the correlations are globally or locally sensitive to the presence of the vortices. For the in-plane correlations the wave-vector dependencies of the width and intensity of the peaks are very well supported by the central peaks, which are observed in a combined Monte Carlo molecular-dynamics simulation of the XY model. Therefore the parameters of the theory (root-mean-square vortex velocity and mean vortex-vortex separation) can be fitted and turn out to agree rather well with independent theoretical estimates. Recent inelastic neutron-scattering experiments on the in-plane correlations for $BaCo_2(AsO_4)_2$ and Rb_2CrCl_4 also show central peaks. Their temperature and wave-vector dependencies are consistent with our results, but their widths are larger than the theoretical estimates. Therefore, these peaks are interpreted to result, at least partially, from a gas of vortices. For the out-of-plane correlations our simulations also show a central peak. However so far it cannot be identified unequivocally as a vortex contribution.

16651 Ferroelastic phase transition and phonons in a diatomic-molecular monolayer. Tang, S.Y.; Jin, W.; Mahanti, S.D.; Kalia, R.K. (Department of Physics, University of California, San Diego, La Jolla, California 92093). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 677-688(1 Jan 1989).

Using a constant-pressure molecular-dynamics simulation, we have investigated the thermodynamics and the dynamics of a two-dimensional diatomic-molecular monolayer undergoing a ferroelastic phase transition. This system closely resembles the δ phase of oxygen molecules adsorbed on a graphite surface. For Lennard-Jones parameters appropriate for the oxygen molecules, we find a first-order transition from an orientationally ordered distorted triangular structure (ferro- elastic phase) to an orientationally disordered equilateral triangular structure (paraelastic phase). The transition temperature is 20.1 K compared with 26 K for oxygen on graphite [coverage ≅8 molecules (100 A^2)] and the entropy associated with this transition is 0.88k/sub B/. The orientational diffusion constant increases by a factor of 30 at the transition. In addition, there is a strong softening of the elastic constants near the transition, particularly in the paraelastic phase; this can be understood in terms of translation-rotation coupling. Comparison between phonon frequencies for certain symmetry directions obtained by using quasiharmonic approximation and molecular-dynamics simulation clearly shows the presence of large anharmonicity effects in the paraelastic phase. A rapid quench from the high-temperature phase to very low temperatures indicates the presence of small clusters (consisting of 6—12 molecules) with both ferroelastic and herringbone ordering. In addition, we find a large density of equilateral triangular plaquettes. These give rise to a three-peak structure in the center-of-mass radial distribution function.

16652 Attractive and repulsive pairing interaction vertices for the two-dimensional Hubbard model. White, S.R.; Scalapino, D.J.; Sugar, R.L.; Bickers, N.E.; Scalettar, R.T. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 839-842(1 Jan 1989).

Particle-hole-magnetic and particle-particle-pairing susceptibilities can be expressed in terms of dressed Green's functions and interaction vertices. Using quantum Monte Carlo simulation techniques, the effect of the interaction vertices is examined to determine the sign and relative magnitude of the effective pairing interaction in various channels for the two-dimensional Hubbard model. Near half filling, we find that the singlet d/sub x//sub <2/-y/sup =/ pairing interaction is the most attractive. The extended near-neighbor s interaction is also weakly attractive, while the singlet s/sub x//sub y/ and d/sub x//sub y/ and the triplet p/sub x/ interactions are repulsive.

16653 X-ray-induced secondary-electron emission from solid xenon. Gullikson, E.M.; Henke, B.L. (Center for X-Ray Optics, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 1, 1-9(1 Jan 1989).

The secondary-electron yield has been measured for solid Xe films excited by (1—10)-keV x rays. High yields are observed due to the long escape depth for secondary electrons (~1 μm). The measurements are discussed in terms of a one-dimensional diffusion model. The electron escape depth is found to be sensitive to the temperature at which the film is grown. The electron yield was found to exhibit a time dependence due to the combined effects of charging and radiation damage. A large increase in the yield was observed when an electric field was applied. Finally, the effects of added impurities, CO_2 and propane, were investigated. It is demonstrated that solid Xe will be useful as a very sensitive x-ray photocathode.

16654 Strain accumulation in quasicrystalline solids. Nori, F.; Ronchetti, M.; Elser, V. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106). *Physical Review Letters;* **61**: No. 24, 2774-2777(12 Dec 1988).

We study the relaxation of 2D quasicrystalline elastic networks when their constituent bonds are perturbed homogeneously. Whereas ideal, quasiperiodic networks are stable against such perturbations, we find significant accumulations of strain in a class of disordered networks generated by a growth process. The grown networks are characterized by root mean square phason fluctuations which grow linearly with system size. The strain accumulation we observe in these networks also grows linearly with system size. Finally, we find a dependence of strain accumulation on cooling rate.

16655 The kinetics of tungsten etching by atomic and molecular chlorine. Balooch, M.; Fischl, D.S.; Olander, D.R. (Univ. of California, Berkeley, CA (US)); Siekhaus, W.J. (Lawrence Livermore National Lab., Livermore, CA (US));. *Journal of the Electrochemical Society;* **135**: No. 8, 2090-2098(Aug 1988).

The reactions of atomic and molecular chlorine with tungsten were studied by modulated beam-mass spectrometric methods over the temperature range 300-1350 K. The atomic beam was generated by an RF plasma discharge. With both atomic and molecular beams, the main reaction product up to about 1000 K was WCl/sub 4/. The reaction probability with atomic chlorine was a factor of approximately ten higher than that obtained with molecular chlorine. The reaction was nonlinear with respect to Cl/sub 2/ intensity at low beam fluxes but approached linearity at high beam intensities. Above 1000 K the main reaction product was atomic chlorine. Its reaction probability increased rapidly with temperature; at 1300 K nearly complete dissociation of Cl/sub 2/ was observed. A kinet-

ic model based on the Eley-Rideal mechanism was proposed and compared with the data.

6561 Superconductivity

REFER ALSO TO CITATION(S) 15106, 15109, 15194, 15237, 15238, 15239, 15240, 15241, 15242, 15243, 15244, 15252, 15256, 15257, 15261, 15263, 15281, 15284, 15288, 15289, 15290, 15294, 15300, 15301, 15314, 15327, 15335, 15340, 15341, 15344, 15653, 16241, 16652

16656 (CEA-CONF—9614) On the relevance of the ac magnetic susceptibility on the study of superconductors. Khoder, A.F.; Couach, M.; Barbara, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR). Dept. de Recherche Fondamentale; Centre National de la Recherche Scientifique, 38 - Grenoble (FR). Lab. Louis-Neel). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 2p. (CONF-880206—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756419/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

It is shown that the ac susceptibility method allows to study in details the bulk superconductivity of as well homogeneous and inhomogeneous materials, such as high-T/sub c/ superconductors. Shielding and Meissner effects at T/sub c/ can be distinguished by a careful analysis of χ' and χ'' components of the susceptibility.

16657 (CEA-CONF—9622) Non-linear soliton excitations in antiferromagnetic chains. Boucher, J.P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 23p. (CONF-880845—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756424/JAW.

From Meeting on nuclear methods in magnetism; Munich, F.R. Germany (1 Aug 1988).

Topological excitations play a crucial role in antiferromagnetic chains. In the present review, we focus on the dynamical fluctuations induced by these quasi-particles, trying to show how they can be observed experimentally. In particular the pulsed nuclear magnetic resonance (NMR) technique can probe these fluctuations at very low frequency. In the same context, neutron spin echo (NSE) measurements are briefly mentioned. A discussion of soliton magnetic resonance (SMR) measurements is also presented: they reveal the existence of internal precessions in the solitons (Dyons) and they show that the uniform (q=0) soliton modes can be detected directly. The experimental data to be discussed were obtained on three compounds: TMMC which provides good examples for broad solitons and CsCoCl/sub 3/ for narrow solitons. A discussion of NMR data obtained with NENP is given in the context of the Haldane's conjecture.

16658 (DOE/ER/45266—T1) Crystalline metal-semiconductor superlattices: Progress report, July 1, 1986--October 31, 1988. Erbil, A. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1988. Contract FG05-86ER45266. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006619/JAW.

In this report, we provide a summary of the progress made during the grant period (July 1, 1986--October 31, 1988). Initially the focus of this program was on the development of underlying science and technology for the fabrication of metal-semiconductor superlattices. The major motivation for this work was to search for excitonic superconductivity in these structures as predicted by theory, in addition to the obvious microelectronic applications. After the discovery of superconductivity with transition temperatures above 77K, naturally we have turned our attention also to this new class of materials. We describe briefly below our work carried under this program on the development of metal-semiconductor superlattices (artificially layered materials) and on the copper oxide based superconductors (naturally layered materials).

16659 (INIS-SU—68, pp 522) Moessbauer effect on /sup 57/Fe and /sup 119/Sn impurity atoms in Er-Ba-Cu-O system. Zhetbaev, A.K.; Vereshchak, M.F.; Ozernoj, A.N.; Sulejmenov, M.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16660 (RAL—88-083) Theory of the measurement of the London penetration depth in uniaxial type II superconductors by muon spin rotation. Barford, W.; Gunn, J.M.F. (Rutherford Appleton Lab., Chilton (UK)). Sep 1988. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705586/JAW.

The effect of anisotropy on the measurement, by muon spin rotation, of the London penetration depth in the high T/sub c/ uniaxial type II superconductors is considered in detail. Expressions are derived which will allow the principal penetration depths, λ/sub 1/ and λ/sub 2/, to be determined using measurements of the μSR line width from single crystals. For polycrystalline, powder or sintered, samples an expression is derived which will allow an effective penetration depth, λ/sub eff/, to be determined from the measured μSR line width. Further, it is shown that for all anisotropy ratios, λ/sub 2//λ/sub 1/, greater than five λ/sub 1/ $\sim$ 0.81λ/sub eff/.

16661 Theory of superconducting wire networks and Josephson-junction arrays in magnetic fields. Niu, Q.; Nori, F. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2134-2150(1 Feb 1989).

In this paper we study the superconducting-normal phase boundaries of a variety of wire networks and Josephson-junction arrays. We have obtained the mean-field phase diagrams for a number of geometries and compared them to the corresponding experimental data. We have introduced an analytical approach to the analysis of the structures present in the phase diagrams. We have shown in great detail how the gross structure is determined by the statistical distributions of the cell areas, and how the fine structures are determined by correlations among neighboring cells in the lattices. We have also studied the effect of thermal fluctuations on the structure of the phase diagram by a cluster mean-field calculation and a real-space renormalization-group (RG) theory. The RG theory provides a natural link between the structures at fractional fluxes to those at integral ones, predicting a pronounced hierarchical behavior of the phase diagram and an infinite slope for the cusps.

16662 Ground-state properties of the two-dimensional antiferromagnetic Heisenberg model. Gross, M.; Sanchez-Velasco, E.; Siggia, E. (Newman Laboratory, Cornell University, Ithaca, New York 14853-5001). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2484-2493(1 Feb 1989).

The ground-state energy, staggered magnetization, and correlation function are computed for the two-dimensional spin-(1/2 quantum antiferromagnetic Heisenberg model (believed to be relevant to the high-temperature superconducting materials without doping) on lattices up to 24 x 24 by Monte Carlo methods extrapolated to zero temperature. A more accurate value for the ground-state energy is determined by the method of Neumann and Ulam by extrapolating from lattices up to 12 x 12.

16663 New type of superconductivity in very high magnetic fields. Tes-hacekanovic, Z.; Rasolt, M. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review [Section] B: Condensed Matter;* **39**: No. 4, 2718-2721(1 Feb 1989).

A new superconducting state is proposed that can coexist with very high magnetic fields, provided that Pauli pair breaking is absent. Such a state may arise, for example, in multivalley semiconductors and semimetals, where the valley degrees of freedom play the role of the electron spins in the usual Bcs theory. Below the transition temperature such superconductors show no resistance to a current flowing in the direction parallel to the field; in the plane

perpendicular to the field, under suitable conditions, their conducting properties will be reminiscent of a quantum liquid of bosons of charge 2e. There is no orbital upper critical field for such superconductors.

16664 Plasmons and high-temperature superconductivity. Mahan, G.D.; Wu, J. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 265-273(1 Jan 1989).

Long-wavelength charge fluctuation models are constructed for 1:2:3 superconductors. These include planar plasmons ($\omega \sim \sqrt{q}$) plus numerous acoustical plasmons ($\omega \sim q$). We show that these modes do not cause pairing of electrons into a superconductor state. Our results rule out interlayer and intralayer pairing by long-wavelength charge fluctuations.

16665 Interfacial effects and superconductivity in high-T/sub c/ materials. Vieira, S.; Zhou, P.; Solin, S.A.; Garcia, N.; Hortal, M.; Aguilo, A. (Center for Fundamental Materials Research, Department of Physics Astronomy, Michigan State University, East Lansing, Michigan 48824). *Physical Review [Section] B: Condensed Matter;* **39**: No. 1, 334-338(1 Jan 1989).

A series of quasihomogeneous superconducting powders of YBa_2Cu_3O/sub 7-//sub x/ have been prepared by sieving and characterized by electron microscopy and x-ray diffraction. Quantitative size-dependent and temperature-dependent magnetic levitation and susceptibility measurements of random powders and of field-oriented (at T<T/sub c/ = 92 K) small grains (<20+μm) confirm previously observed symmetry-breaking effects associated with the twin boundary planes and suggest that the bulk anisotropic superconductivity is measurably perturbed by interfacial effects. Current models of interfacial superconductivity on high-T/sub c/ materials are evaluated in light of these and other results and found to be lacking.

16666 Polarization-induced pairing - an excitonic mechanism for high-temperature superconductivity. Martin, R.L.; Bishop, A.R.; Tesanovic, Z. pp 130-137 of Chemistry of high-temperature superconductors II; Proceedings of the Symposium, Los Angeles, CA, Sept. 25-30, 1988. Nelson, D.L.; George, T.F. Washington, DC; American Chemical Society (1988). (CONF-8809275—).

From Chemistry of high-temperature superconductors II symposium; Los Angeles, CA, USA (25 Sep 1988).

The qualitative aspects of a recently proposed mechanism for superconductivity based on intraband and interband Cu-O charge transfer excitations in the cuprates are reviewed. In this model, the dynamic polarizability of the environment surrounding the CuO_2 planes plays an important role in enhancing Tc. The sandwich structures of $YBa_2Cu_3O_7$, $Bi_2Sr_2CaCu_2O_8$, and $Tl_2Ba_2Cu_3O_{10}$ are ideally suited to this mechanism. The high Tc design principles suggested by the model are commented on. 14 references.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 15603, 16267, 16268, 16269, 16270, 16271, 16354, 16405, 16567, 16645, 16646, 16713

16667 (BI-TP—88/26) On the quantum Fermi accelerator and its relevance to 'quantum chaos'. Karner, G. (Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik). 1988. 18p. Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik.

We discuss a quantum version of the Fermi acceleration model, which consists of a particle bouncing between a fixed and oscillating wall. The actual movement of the particle crucially depends on the boundary conditions of the Schroedinger equation. Under Dirichlet b.c. the quantum system displays a regular behaviour, but its classical limit exhibits some unphysical attributes. Only for certain initial conditions it corresponds to the stable motion of a ball bouncing once for an integer number of wall oscillations. In the classical model that situation gives rise to regular islands imbedded in the chaotic sea.

16668 (BiBoS—327/88) Quantum stochastic optimization. Apolloni, B.; De Falco, D.; Carvalho, C. (Milan Univ. (Italy). Dipt. di Scienze dell'Informazione; Centro de Fisica da Materia Condensada, Lisbon (Portugal); Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik). (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS); Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik). Aug 1988. 22p. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

We propose a combinatorial optimization procedure based on the physical idea of using the quantum tunnel effect to allow the search of global minima of a function of many Boolean variables to escape from poor local minima. More specifically, the function V to be minimized is viewed as the potential energy term in a Schroedinger Hamiltonian H for a quantum spin 1/2 system, the kinetic energy term being the generator of an asymmetric random walk tailored to the neighborhood structure associated with V. The distorted random walk associated with (a suitable approximation of) the ground state eigenfunction of H defines then our approximate optimization strategy. A numerical application to the graph partitioning problem is presented.

16669 (BNL—42132) Are earthquakes, fractals, and 1/f noise self-organized critical phenomena?. Bak, Per; Tang, Chao; Wiesenfeld, K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-8808188—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005771/JAW.

From 2. Yukawa international seminar: cooperative dynamics in complex dynamical systems; Kyoto, Japan (23 Aug 1988).

Spatially extended dynamical systems can evolve towards a "self-organized" critical state. We suggest that several phenomena which are known to have temporal or spatial power law correlations are manifestations of this state. The Gutenberg-Richter law for the distribution of earthquakes indicates that the occurrences of earthquakes is a critical phenomenon. 6 refs., 3 figs.

16670 (CBPF-NF—002/88) Comment on Surface magnetization of Gd at the bulk Curie temperature. Chame, A.M.N.; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705398/JAW.

We comment on the discontinuity of the first temperture derivative, at the bulk critical temperature, of the surface magnetization of ferromagnets with a free surface, question which has recently been focused by Rau and Robert.

16671 (CBPF-NF—038/88) Scaling factors associated with M-furcations of the 1-a [x]/sup z/ map. Sousa Vieira, M. da C. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705403/JAW.

We study numerically the scaling behavior associated with M-furcations (M=3,4,5) in the map x/sub t+1/ =1 - a [x/sub t/]/sup z/ (z > 1). The scaling constants delta and α, as function of z, are calculated, as well as the more general scaling functions σ and f (a).

16672 (CBPF-NF—039/88) Skyrme topological soliton coupled to gravity. Glendenning, N.K.; Kodama, T.; Klinkhamer, F.R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705404/JAW.

Skyrmions of large topological quantum number, N, or large energy scale, f/sub PI/, are studied in general relativity. No stable or metastable solutions are found between the nucleon with N = 1 and mini-black holes with N ~ M/sub Plank/ / f/sub PI/. On the nuclear scale (f sub(PI) ~ 90 MeV) this corresponds to N ~ 10/sup 19/.

16673 **(CBPF-NF—048/88) Equivalence of the propagator of quasi-statical solutions and the quantum harmonic oscillator.** Bonato, C.A.; Thomaz, M.T.; Malbouisson, A.P.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705411/JAW.

We establish a connection between a two-dimensional field theory possessing a classical solution depending on only one of the coordinates, and the quantum mechanical harmonic oscillator whose frequency is one coordinate-dependent.

16674 (CONF-870155—, pp 435-438) **Oscillator model of atomic stopping.** Sigmund, P. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

This paper is a summary of two papers on oscillator models of atomic stopping and energy loss. (JF)

16675 (CONF-870155—, pp 539-554) **Collision cascades as fractals.** Winterbon, K.B.; Urbassek, H.M.; Sigmund, P.; Gras-Marti, A. Apr 1988. NTIS, PC A23 - OSTI. Order Number DE88008882/JAW.

From 10. Werner Brandt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

Collision cascades in matter irradiated with heavy particles (ions, atoms, etc.) are seen to be approximate fractals, and their fractal dimension is calculated and discussed. Experimental and theoretical collision cascades are expected to be useful laboratories for the study of fractals. The "measuring rod" dimension of the cascade considered as a set of particle paths ranges from 1 for relatively high-energy projectiles to 3 or higher for low-energy ones; the "density" and "subdivision" dimensions of the cascade considered as a distribution of energy, when greater than 1, agree with the former but can decrease to 0. Some other fractal aspects of atomic collisions in matter are commented on. 12 refs., 2 figs.

16676 (IA—1440, pp 19-20) **Arbitary-grid cell-mixing stochastic simulation for multi-dimensional diffusion: Pt. 1. Theory.** Karni, Y.; Bar-Ziv, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16677 (IA—1440, pp 20) **Arbitary-grid cell-mixing stochastic simulation for multi-dimensional diffusion: Pt. 2. Numerical examples.** Karni, Y.; Goldstein, M.; Bar-Ziv, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16678 **(IAE—4615/12) 0(2,1)-algebra representations in the problems of bound states in the Coulomb many-body systems.** Frolov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705449/JAW.

The problem of bound states in the Coulomb many-body systems is considered. It is shown that using 0(2,1)-algebra representations one can simplify essentially the analysis of such problems and make the methods more universal for their solution. For the N-electron atom the existence of the hyperradial 0(2.1)-algebra makes possible to avid numerical solution of the hyperradial Shroedinger equation and make some a priori estimates of the energy spectrum. Use of appropriate 0(2.1)-algebras and their representation permits to explain more rapid convergence of variational expansions in relative coordinates in the analysis of bound states of the Coulomb three-body systems. The final part of the paper demonstartes how using non-compact algebras one can reduce the Coulomb two center problem to solution of two one-center problems in non-Euclidean space. 20 refs.

16679 **(IC—88/307) Multifractals.** Amritkar, R.E.; Gupte, N. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1988. 185p. NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88705369/JAW.

We review the framework set up for the multifractal analysis of self-similar sets. This framework provides a way of extracting the singular structure of the sets analysed and has proven to be useful in a wide variety of physical contexts. We discuss some of the diverse applications of the framework. The framework has also provided the basis for significant advances in the analysis of dynamical systems. We review various developments based on the multifractal framework. These include the thermodynamic formalism, the inverse problem and the framework required for partially self-similar sets. We discuss the consequences of these developments for the analysis of attractors of systems on the border-line of chaos and give an outline of the developing field of the analysis of chaotic attractors. A brief account of other developments like the effect of fluctuations and the renormalization group analysis of multifractals is also provided. (author). 111 refs, 9 figs, 2 tabs.

16680 **(IFT-P—06/88) Long range local effective potential for three particle system.** Delfino, A.; Frederico, T.; Tomio, L. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica; Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil)). (Instituto de Fisica Teorica, Sao Paulo, SP (Brazil)). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705466/JAW.

We derive the long range behaviour of an effective interaction for a system with three identical particles. We start our derivation from the zero range theory in configuration space and we show that the asymptotic effective potential, in the relative distance of the subsystem to the third particle, goes as - exp (-λr)/(r/sup 3/ 2/).

16681 **(IFUSP-P—717) Statistical mechanics for solitons in liquid Helium. I.** Evangelista, L.R.; Ventura, I. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Jun 1988. 67p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705474/JAW.

This paper presents a /sup 4/He liquid microscopic theory, based on the existence of planar solitons, which move in equilibrium on fluid's condensate. Inside every soliton, there is a cloud of bound states thermal excitations. The normal fluid is made of unbound states excitations, and the action of solitons and thermal clouds over them, is approximated by a mean field, which depends on the system's number of solitons. The bound stat quasi-particles, that make up the thermal cloud, are in turn described through a self-consistent calculation. In thermal cloud dynamics, and owing to the motion of solitons, the lower energy state is an instantaneous wave packet, at rest in the laboratory frame. There is an energy gap between the instantaneous packet and the normal modes bound to the soliton. However, since the instantaneous packet is the ground state, then it condensates a second classical field, proportional to its wave function, that interacts with the condensate field, and is also a coherent envelope, which modulates the thermal cloud states, stabilizing it. In this paper, the thermal cloud is introduced through a self-consistent classical density rho/sub n.t./ (x-vector,t). In the next paper we show the perfected approach of treating the thermal cloud by means of the second classifical field, which condensates in the lowest energy state. This field is the coherent envelope of the cloud bound states.

16682 **(IFUSP-P—718) Statistical mechanics for solitons in liquid Helium. II.** Evangelista, L.R.; Ventura, I. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Jun 1988. 28p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705475/JAW.

The thermal cloud is perfected through the introduction of the second condensate field psi/sub c/, that condensates in the instantaneous packet wave function, and provides a coherent envelope to modulate the bound states. The squared amplitude of the second classical field [psi/sub c/]/sup 2/, is equal to the thermal cloud density. The bound -state zero-point kinetic energy belongs

now to the classical field kinetic term, and this leads us to subtract another counter-term from the thermal cloud Hamiltonian. It then results a new gap, given by the kinetic energy, 1/2 m c-tilde V)/ sup 2/, that is due to the soliton's motion. Besides the superfluid and the normal liquid, we report the theoretical existence of two other phases.

16683 **(IFVE-OTF—88-6) Reparametrization in the path integral over finite dimensional manifold with a time-dependent metric.** Storchak, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705484/JAW.

The path reparametrization procedure in the path integral is considered using the methods of stochastic processes for diffusion on finite dimensional manifold with a time-dependent metric. the reparametrization Jacobian has been obtained. The formulas of reparametrization for a symbolic presentation of the path integral have been derived. 17 refs.

16684 **(IFVE-OTF—88-118) Rebound from Schwarzschild sphere in RTG with nonzero graviton mass.** Vlasov, A.A.; Logunov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705488/JAW.

Submitted to the journal Intern. J. Modern Phys. A.

In the relativistic theory of gravitation (RTG) singularity on the Schwarzschild sphere is a true singularity. Static spherically symmetric bodies in RTG cannot have dimensions less than Schwarzschild radii. The point r=2m is the turning point (or "rebound" point) and is reached at finite time, both coordinate and proper, for radially falling particle or light beam. Therefore, the absence of black holes and gravitational collapse in RTG has been confirmed. 3 refs.

16685 **(INIS-BR—1398) Determination of the magnetic impurities contribution to the nuclear relaxation in metals.** Cohen, A.M. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1982. 95p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705511/JAW.

The renormalization group techniques developed by Wilson for the Kondo problem are applied, for the first time, to the calculation of nuclear spin relaxation rates in dilute magnetic alloys. A procedure that calculates the longitudinal relaxation time T/sub 1/ over the entire temperature range 0 < k/sub B/T < D, where D is the conduction bandwidth, is introduced. In particular for T=0 and analytical expression for T/sub 1/ is derived; for distances R between the impurity and the nucleus large compared to the inverse Fermi momentum H/sub f/, the result is identical to Korringa's expression for the nuclear spin relaxation rate in the pure metal. For smaller k/sub F/R, T/sub 1/ increases and becomes infinite as k/sub F/ R->0. A numerical approach, capable of calculating T/sub 1/ at finite temperatures, is presented and tested by calculating T/sub 1/ for T->0; the numerical results are in excellent agreement with the analytical expression discussed above. Only for k/sub F/ R-> infinity do the results for T/sub 1/ at T=0 agree with those found by Roshen and Saam, who recently analysed this problem in the light of Nozieres's Fermi liquid theory. The reasons for the discrepancy for finite k/sub F/R are discussed.

16686 **(INIS-BR—1399) Study on electronic mobility in InGaAsP compounds.** Ceolin, M.F. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). Oct 1983. 68p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705512/JAW.

We compute, from experimental data two important elements to the Knowledge of the mechanisms of charge transport in the InGaAsP semiconductor alloy: the density of ionizable impurities and the scattering potential by disorder of the lattice. (M.W.O.).

16687 **(INIS-BR—1403) Study on guided waves in semiconductor lasers.** Pudensi, M.A.A. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica). 1980. 121p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705516/JAW.

In This work we studied the guided waves in semiconductor lasers. In the first part we carried on the experimental measurements on lasers with stripe nonorthogonal to the mirrors. In the second part we developed a matrix method for the study of propagation and reflection of guided waves in lasers.

16688 (INIS-SU—69, pp 45-46) **Bremsstrahlung in the Aharonov-Bohm effect.** Serebryannyj, E.M.; Skarzhinskij, V.D. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.

In Experimental and theoretical physics. Collection.

The bremsstrahlung process during electron scattering on the solenoid magnetic flux is considered. The expression for. 4 refs.

16689 **(ITEP—43(1988)) On the rotation of light polarization vector in the nonstationary gravitational field.** Kobzarev, I.; Selivanov, K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705552/JAW.

It is shown that the direction of the polariztion vector of light passing near the binary star does oscillate periodically. It is also proved that in case of light ray moving in the stationary field the total rotation angle of polarization is equal to zero in weak field approximation. 6 refs.; 1 fig.

16690 **(ITEP—195(1987)) On the possibility of Pauli principle violation in atoms.** Okun', L.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705555/JAW.

A free nonrelativistic field-theoretical model is constructed which explicitly violates the Pauli principle. The difficulties of switching on the electromagnetic interaction and of casting the theory in relativistically invariant for are discussed. Experimental searches for "non-paulian" atoms with anomalously filled electron and/or nuclear shells are suggested. 9 refs.

16691 **(SLAC-PUB—4836) Where we are.** Noyes, H.P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 32p. (CONF-8808181—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005945/JAW.

From 10. annual international meeting of the Alternative Natural Philosophy Association; Cambridge, UK (25 Aug 1988).

The conceptual consequences, cosmology and physical predictions stemming from the combinatorial hierarchy and a discrete physics model based on McGoveran's ordering operator calculus are reviewed. We conclude that we have made a strong case for this approach to the foundations of physical science. 34 refs.

16692 **(UCRL—99866) Collective methods for simulating transition arrays.** Bloom, S.D.; Rozsnyai, B.F. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 27p. (CONF-8807149—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005656/JAW.

From CECAM workshop on photoabsorption by astrophysical and laboratory plasmas; Paris, France (18 Jul 1988).

We review the different methods based on the principal of the "Collective Vector" (CV) as described in several recent publications. All of these methods are used for the purpose of simulating atomic transition array spectra with many fewer lines than are contained in the actual microscopic spectrum. There are three principal methods two of which ((1) and (3)) employ the Lanczos algorithm: (1) the Lanczos/CV method wherein a full diagonalization is performed in an appropriate parent model space and a CV is formed

from each parent eigenvector; (2) the Monte Carlo/CV method wherein a single CV is made from a single random parent vector. Moments of the transition array can then be statistically evaluated from the CV and the random parent vector using the system Hamiltonian and the El operators. For large spaces this method is rapidly convergent for moments up to very high order; (3) and the third method, which we call the Monte Carlo/CV/Lanczos method, is a combination of methods (1) and (2) and has the advantage of being the most compact of the three. This is because it simulates a spectrum most efficiently, which is to say with the smallest computational effort. 5 refs., 11 figs., 4 tabs.

16693 **(UFPB-DF—03/88) Ladder operators from the Wigner-Heisenberg algebra for the 3d-isotropic and the 1d-isotonic oscillators and supersymmetry.** Jayaraman, J.; Lima Rodrigues, R. de. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705598/JAW.

We elucidate the important connection of the Wigner-Heisenberg algebra and the consequent Wigner's general oscillator quantum rule for the 3D-isotropic, 1D isotonic and d-dimensional radial oscillator systems. (M.W.O.).

16694 **(X-EP-CPT-RA—1985) Annual report of the Center for Theoretical Physics.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 12p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756697/JAW.

Research on dynamical systems; statistical physics; string theory; field theory; elementary particle physics (QCD, standard model, GUT); plasma physics (inertial and magnetic confinement); astrophysics; and statistical mechanics is presented.

16695 **(X-EP-CPT-RA—1986) Annual report of the Center for Theoretical Physics, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 30p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756698/JAW.

Research on dynamical systems; statistical physics; string theory; field theory; elementary particle physics (QCD, standard model, GUT); plasma physics (inertial and magnetic confinement); astrophysics; and statistical mechanics is presented.

16696 **(X-EP-LOA-RA—1985) Annual report of the Applied Optics Laboratory, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 19p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756707/JAW.

Research on optical fiber coupling by evanescent fields; fiber optics resonators; infrared lasers; remote measurement by laser; dephasing time in GaAs; heat transfer in thin silicon films; quantum wells; a picosecond electron source; modeling of III-V semiconductors; nonlinear optics properties of materials; femtosecond spectroscopy of the internal dynamics of proteins; computer simulation of protein dynamics; electron solvation; reactions of radicals in micella phase; sarcoma; and medical applications of pulsed lasers is presented.

16697 **(X-EP-LOA-RA—1986) Annual report of the Applied Optics Laboratory, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 26p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756708/JAW.

Research on optical fiber coupling by evanescent fields; fiber optics resonators; infrared lasers; remote measurement by laser; dephasing time in GaAs; heat transfer in thin silicon films; quantum wells; a picosecond electron source; modeling of III-V semiconductors; nonlinear optics properties of materials; femtosecond spectroscopy of the internal dynamics of proteins; computer simulation of protein dynamics; electron solvation; reactions of radicals in micella phase; sarcoma; and medical applications of pulsed lasers is presented.

16698 **Locating stationary paths in functional integrals: An optimization method utilizing the stationary phase Monte Carlo sampling function.** Beck, T.L.; Doll, J.D.; Freeman, D.L. (Los Alamos National Laboratory, MS G-738, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **90**: No. 6, 3181-3191(15 Mar 1989).

A method is presented for determining the stationary phase points for multidimensional path integrals employed in the calculation of finite-temperature quantum time correlation functions. The method can be used to locate stationary paths at any physical time; in the case that $t>>\beta(h/2\pi)$, the stationary points are the classical paths linking two points in configuration space. Both steepest descent and simulated annealing procedures are utilized to search for extrema in the action functional. Only the first derivatives of the action functional are required. Examples are presented first of the harmonic oscillator for which the analytical solution is known, and then for anharmonic systems, where multiple stationary phase points exist. Suggestions for Monte Carlo sampling strategies utilizing the stationary points are made. The existence of many and closely spaced stationary paths as well as caustics presents no special problems. The method is applicable to a range of problems involving functional integration, where optimal paths linking two end points are desired.

16699 **Multivariable biorthogonal Hahn polynomials.** Tratnik, M.V. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545). *Journal of Mathematical Physics (New York);* **30**: No. 3, 627-634(Mar 1989).

A multivariable biorthogonal generalization of the discrete Hahn polynomials, a p+1 complex parameter family, where p is the number of variables, is presented. It is shown that the polynomials are orthogonal with respect to subspaces of lower degree and biorthogonal within a given subspace. These properties are over the discrete simplex $0 \leqq x_1+x_2+xxx+x/\text{sub } p/ \leqq \Delta$, where $x_1, x_2,...,x/\text{sub } p/$ and Δ are non-negative integers. Some further properties of the closely related multivariable continuous Hahn polynomials are also discussed.

16700 **Approximation for the on-axis field of an elliptical piston transducer.** Newberry, B.P.; Rose, J.H. (Ames Laboratory, USDOE, Iowa State University, Ames, Iowa 50011). *Journal of the Acoustical Society of America;* **85**: No. 3, 1357-1359(Mar 1989).

An approximate analytic formula is given for the on-axis pressure of a baffled, elliptically shaped piston transducer. This approximate formula results from truncating an exact series expansion for the integral that determines the on-axis pressure. The reported formula is considerably more accurate than the previous expression. The accuracy and range of validity of the new result are determined by comparison with a numerical evaluation of the relevant integral.

16701 **Note on the fluctuations of noninteracting particles.** Rahal, V. (Department of Physics, The Rockefeller University, 1230 York Avenue, New York, New York 10021). *American Journal of Physics;* **57**: No. 3, 238-240(Mar 1989).

The exact expression is derived for the fluctuation in the number of particles of a system of noninteracting fermions or bosons. The result shows in an instructive way the additional fluctuation due to the symmetrization postulate of quantum mechanics.

16702 **Transition-state theory for quantum and classical particle escape from a finite square well.** Tsao, J.Y. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *American Journal of Physics;* **57**: No. 3, 269-274(Mar 1989).

A precise statement of transition-state theory is given. The theory is made intuitive and precise by the introduction of a "semipermeable" barrier between reactant and product. The theory is then illustrated by calculating, both quantum and classical mechanically, the rate of particle escape from a finite square well. The two calculations are fundamentally different and illuminate different aspects of the theory. Finally, the solution is recast into the Arrhenian form with which it is usually identified, and physically satisfy-

ing expressions for the rate prefactor, activation energy, and activation entropy are obtained.

16703 **Localized transmission of electromagnetic energy.** Ziolkowski, R.W. (Engineering Research Division (L-156), Lawrence Livermore National Laboratory, University of California, P.O. Box 5504, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 4, 2005-2033(15 Feb 1989).

Novel electromagnetic directed-energy pulse train (EDEPT) solutions of Maxwell's equations have been obtained. One particular solution, the modified-power-spectrum (MPS) pulse, will be described in detail. EDEPT's such as the MPS pulses, can be tailored to give localized energy transmission along a specified direction in space that is significantly improved over conventional diffraction-limited beams. Moreover, they represent fields that recover their initial amplitudes along the direction of propagation at extremely large distances from their initial location. These EDEPT solutions are not physically pathological and can be reconstructed from causal Green's functions. In fact, these fields appear to be launchable from finite-aperture antennas.

16704 **Equilibrium and nonequilibrium Lyapunov spectra for dense fluids and solids.** Posch, H.A.; Hoover, W.G. (Institute for Experimental Physics, University of Vienna, Boltzmanngasse 5, Vienna A-1090, Austria). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 4, 2175-2188(15 Feb 1989).

The Lyapunov exponents describe the time-averaged rates of expansion and contraction of a Lagrangian hypersphere made up of comoving phase-space points. The principal axes of such a hypersphere grow, or shrink, exponentially fast with time. The corresponding set of phase-space growth and decay rates is called the "Lyapunov spectrum." Lyapunov spectra are determined here for a variety of two- and three-dimensional fluids and solids, both at equilibrium and in nonequilibrium steady states. The nonequilibrium states are all boundary-driven shear flows, in which a single boundary degree of freedom is maintained at a constant temperature, using a Nose-Hoover thermostat. Even far-from-equilibrium Lyapunov spectra deviate logarithmically from equilibrium ones. Our nonequilibrium spectra, corresponding to planar-Couette-flow Reynolds numbers ranging from 13 to 84, resemble some recent approximate model calculations based on Navier-Stokes hydrodynamics. We calculate the Kaplan-Yorke fractal dimensionality for the nonequilibrium phase-space flows associated with our strange attractors. The far-from-equilibrium dimensionality may exceed the number of additional phase-space dimensions required to describe the time dependence of the shear-flow boundary.

16705 **Squeezing in harmonic oscillators with time-dependent frequencies.** Ma, X.; Rhodes, W. (Department of Chemistry, Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 4, 1941-1947(15 Feb 1989).

It is shown that squeezing will inevitably be generated in a harmonic oscillator with time-dependent frequency for any nonvanishing rate of frequency change, sudden or smooth. The general form of the time-dependent transition probabilities among the eigenstates of the initial Hamiltonian is obtained with an exact operator approach. Results for the case of a sudden frequency jump are explicitly given as an illustration. It is also pointed out that to generate squeezing in a harmonic oscillator, the Hamiltonian does not have to be a unitary squeeze transformation of the free Hamiltonian.

16706 **Reflectionless symmetric potentials from vertex operators.** Kwong, W.; Riggs, H.; Rosner, J.L.; Thacker, H.B. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 4, 1242-1245(15 Feb 1989).

The construction of symmetric reflectionless potentials with an arbitrary bound-state spectrum is compared using supersymmetric quantum mechanics and using vertex operators. The simplicity of each method may have useful consequences for the other.

16707 **Spectral representation for the polarizability of a collection of dielectric spheres.** Fuchs, R.; Claro, F. (Ames Laboratory—U.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 6, 3875-3878(15 Feb 1989).

The spectral representation, which gives the dipole strengths and depolarization factors of the collective surface modes, is determined for an arbitrary collection of dielectric spheres. Average depolarization factors are calculated for a line of unequal spheres.

16708 **Limits on composition-dependent interactions using a laboratory source: Is there a "fifth force" coupled to isospin?.** Stubbs, C.W.; Adelberger, E.G.; Heckel, B.R.; Rogers, W.F.; Swanson, H.E.; Watanabe, R.; Gundlach, J.H.; Raab, F.J. (Physics Department, University of Washington, Seattle, Washington 98195). *Physical Review Letters;* **62**: No. 6, 609-612(6 Feb 1989).

Previous "fifth-force" experiments searched for differential acceleration of test bodies placed near terrestrial sources. Because these sources have $N \simeq Z$ the results had little sensitivity to forces coupled to $B\text{-}2L = N\text{-}Z$. We searched for such forces by placing a 1-ton Pb source close to a Be/Al torsion balance. Our null results rule out (at 2σ) the possibility that all previous composition-dependence results could be due to a force coupling predominantly to B-2L with a range $\lambda < 100$ m. We also set improved constraints on new interactions with $0.3 \leqq \lambda \leqq 10$ m.

16709 **Path integrals in Hamiltonian systems: Breakup of the last Kolmogorov-Arnold-Moser torus due to random forces.** Gyoergyi, G.; Tishby, N. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). *Physical Review Letters;* **62**: No. 4, 353-356(23 Jan 1989).

Transport in three-dimensional nonintegrable Hamiltonian flows is studied and the destruction of Kolmogorov-Arnold-Moser barriers in the presence of stochastic perturbations described. We extend the action principle to Hamiltonians with small noise, which provides a framework to determine universal scaling of characteristic times as a function of the noise.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 16406

16710 **Challenges of muon catalyzed fusion.** Rafelski, J. (Department of Physics, University of Arizona, Tucson AZ 85721). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 451-464(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

This is a survey of new and significant developments which promise to shape the future of muon catalyzed fusion, based on presentations made at the 1988 MuCF workshop. The new ideas about muon production, muon sticking, regeneration and the muomolecular reactions represent steady progress towards understanding of the basic physics of MuCF and reaching towards 1,000 fusions per muon. I will attempt to elucidates the progress made in the theory of MuCF and to illustrate the practical importance of some of the issues raised. In many instances I will follow my personal viewpoint, justifying as much as possible the reasons behind my judgement.

7001 Plasma Research

REFER ALSO TO CITATION(S) 14470, 15677, 15678, 15681, 15682, 15691, 16255, 16471, 16694, 16695, 16808, 16818, 16830, 16831

16711 **(CONF-881124—2) 2D full-wave modeling of ICRH with finite E{parallel}.** Batchelor, D.B.; Jaeger, E.F.; Weitzner, H. (Oak Ridge National Lab., TN (USA); New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004921/JAW.

From Joint Varenna-Lausanne workshop on theory of fusion plasmas; Chexbres, Switzerland (3 Nov 1988).

In this paper, the Oak Ridge ion cyclotron wave propagation code ORION has been extended to include nonzero E{parallel} in both axisymmetric tokamak and helically symmetric stellarator geometries. Flux surfaces, conducting boundaries, and antennas can be of arbitrary shape, and antenna current is assumed to be divergence free (not a necessary assumption). Cartesian coordinates eliminate the singularity that occurs at the origin of cylindrical coordinate systems. In this paper we consider two alternative numerical approaches to this problem. One solves Maxwell's equations directly in terms of the electric field {rvec E}. The second approach introduces the electromagnetic potentials {rvec A} and {phi} with the Coulomb gauge {triangledown} {center←dot} {rvec A} = 0. 7 refs., 4 figs.

16712 **(DOE/ER/53214—11) [Extreme ultraviolet and soft x-ray diagnostics of high-temperature plasmas]: Progress report.** Moos, W. (Johns Hopkins Univ., Baltimore, MD (USA)). 1989. Contract FG02-86ER53214. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007070/JAW.

This paper describes recent progress in experiments performed on the TEXT and DIII-D tokamaks. This paper also discusses our future plans for the on-going work related to the poloidal magnetic field diagnostic and edge and scrape-off plasma physics and the novel diagnostics and their scientific and technical background. The budget is discussed briefly.

16713 **(DOE/ET/53088—358) Application of Newton's method to Lagrangian dynamical systems.** Kook, Hyung-tae; Meiss, J.D. (Texas Univ., Austin (USA). Inst. for Fusion Studies). 3 Jan 1989. Contract FG05-80ET53088. 19p. (IFSR—358). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007024/JAW.

An algorithm for Newton's method is presented to find periodic orbits for N degree-of-freedom Lagrangian mappings. The computation time of the method is proportional to n, the period of the orbit, and the required storage space is reduced to o(n). The construction of the algorithm is based upon block-diagonalization of the Hessian matrix of the action function. The index of the action function, which is closely related to orbital stability, is obtained during execution of the algorithm. 12 refs., 1 fig.

16714 **(DOE/ET/53088—361) Suppression of sawtooth oscillations due to hot electrons and hot ions.** Zhang, Y.Z.; Berk, H.L. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jan 1989. Contract FG05-80ET53088. 15p. (IFSR—361). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007025/JAW.

The theory of m = 1 kink mode stabilization is discussed in the presence of either magnetically trapped hot electrons or hot ions. For instability hot ion requires particles peaked inside the q = 1 surface, while hot electrons require that its pressure profile be increasing at the q = 1 surface. Experimentally observed sawtooth stabilization usually occurs with off-axis heating with ECRH and near axis heating with ICRH. Such heating may produce the magnetically trapped hot particle pressure profiles that are consistent with theory. 17 refs., 2 figs.

16715 **(ENEA-RT-TIB—87-51) XeCl discharge diagnostic by holographic interfenometry.** De Angelis, A.; Di Lazzaro, P.; Garosi, F.; Giordano, G.; Letardi, T. (ENEA, Frascati (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705440/JAW.

A direct measurement of the electron density time evolution in the active medium of a self-sustained XeCl laser discharge has been performed by means of the holographic interferometry technique. The time and space resolved behaviour of the discharge seems to confirm that the halogen deplation instability and the hot spots developing in the cathode region are the basic machanisms which determine the premature termination of the output laser pulse. 19 refs.

16716 (IA—1440, pp 63-65) **Electron transport in steep temperature gradients in hot dense plasmas.** Fried, N.; Shvarts, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16717 (IA—1440, pp 65-68) **Filamentation of laser light in preformed plasmas.** Havatzelet, D.; Shvarts, D.; Capjack, C.E.; Marchand, R. (Israel Atomic Energy Commission, Tel Aviv; Alberta Univ., Edmonton (Canada)). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16718 (IA—1440, pp 68-69) **Spontaneous inhibition, radiation propagation and gain buildup in hot-plasma x-ray lasers.** Hazak, G.; Bar-Shalom, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16719 **(IFUSP-P—603) Destruction of magnetic surfaces by resonant helical windings.** Fernandes, A.S.; Heller, M.V.; Caldas, I.L. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Oct 1986. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705472/JAW.

Helical winding current thresholds for the destruction of magnetic surfaces in large aspect-ratio tokamaks are estimated. The influence of magnetic islands created by external windings and by tearing instabilities on the disruptive instability is considered. The radial dependence of the perturbations and the change in the shear over the islands widths are taken into account. Ergodization due to secondary islands caused by the coupling between the resonant helical fields and the toroidal curvature are also considered.

16720 (INIS-SU—68, pp 534) **Gamma-spectroscopy of thermonuclear deuterium plasma.** Kiptilyj, V.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

16721 (INIS-SU—69, pp 42-44) **On fields of charges in a plasma near mirror-reflecting boundaries.** Vladimirov, S.V. (AN SSSR, Moscow. Inst. Obshchej Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.

In Experimental and theoretical physics. Collection.

It is shown that the presence of a mirror-reflecting boundary in plasma is considerable in the case of calculating capacity fields of charges at small distances from this boundary. 2 refs.

16722 (INIS-SU—69, pp 33-35) **Three-electrode asymmetrical probe for continuous measurement of plasma density and temperature.** Ivanov, V.A. (AN SSSR, Moscow. Inst. Obshchej Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780060/JAW.

Kratkie Soobshcheniya po Fizike.; no. 6.
In Experimental and theoretical physics. Collection.

The functioning of three-electrode asymmetrical plasma probe immerged in inhomogeneous and nonisothermal plasma is considered. The formula connecting the value of plasma electron temperature with the measured voltage between symmetrical electrodes and currents in the circuits of symmetrical and asymmetrical electrodes is obtained. 9 refs.; 1 fig.

16723 **(INPE—4576) Intense particle beam and multiple applications.** Ueda, M.; Machida, M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). 1988. 41p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705538/JAW.

The Multiple Application Intense Particle Beam project is an experiment in which an injector of high energy neutral or ionized particles will be used to diagnose high density and high temperature plasmas. The acceleration of the particles will be carried out feeding a diode with a high voltage pulse produced by a Marx generator. Other apllications of intense particle beam generated by this injector that could be explored in the future include: heating and stabilization of compact toroids, treatment of metallic surfaces and ion implantation.

16724 **(INPE—4605) Experimental studies on the surface confined quiescent plasma at INPE.** Ferreira, J.L.; Ferreira, J.G.; Sandonato, G.M.; Alves, M.V.; Ludwig, G.O.; Montes, A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Jun 1988. 11p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705540/JAW.

Quiescent plasma machines are being used in several experiments at the Associated Plasma Laboratory in INPE. The research activities comprises particle simulation studies on ion acoustic double Layers, and studies on the plasma production and loss in surface confined magnetic multidipole thermionic discharges. Recent results from these studies have shown a non-maxwellian plasma formed in most of the discharge conditions. The plasma leakage through the multidipole fields shows an anomalous diffusion process driven by ion acoustic turbulence in the magnetic sheath. The information derived from these studies are being used in the construction and characterization of ion sources for shallow ion implantation in semiconductors, in ion thruster for space propulsion and in the development of powerful ion sources for future use in neutral beam injection systems.

16725 **(KIYI—87-25) Investigation of HF-discharge in crossed variable electric and constant magnetic fields.** Naumovets, V.G.; Yagola, V.V. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1987. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705578/JAW.

The HF-discharge plasma behaviour in crossed variable electric and constant magnetic fields is studied experimentally. The technique to measure the HF-field intensity in plasma - E/sub pl/ is developed and the measurements are carried out under various experimental conditions. The magnetic field presence is shown to increase E/sub pl/ substantially. The HF-power absorption in plasma and the effective frequency of electron collisions is estimated. The qualitative analysis is carried out which make possible the simulation of the magnetic field effect upon plasma and near-electrode layers of a HF-discharge. 31 refs.; 19 figs.

16726 **(LA-UR—88-4231) Ion-acoustic waves and drift waves in negative ion sources.** Gerwin, R.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890145—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005474/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

Attention is directed towards instabilities induced in hydrogen plasmas due to the presence of the desired H/sup {minus}/ ions. Preliminary investigations indicate that when the electron temperature exceeds the temperature of the background ions (H^+), the H/sup {minus}/ beam causes collective instabilities even at very low (even vanishing) beam velocities, provided that the non-ideal properties of the background plasma are taken into consideration. The most dangerous instabilities involve oscillations transverse to the direction of beam extraction, and may thereby degrade the beam emittance. 5 refs.

16727 **(LA-UR—88-4232) Improved plasma confinement and evidence for a pressure-driven instability from reduced magnetic field errors in the CTX spheromak.** Fernandez, J.C.; Wysocki, F.J.; Jarboe, T.R.; Barnes, C.W.; Henins, I.; Knox, S.O.; Marklin, G.J. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890302—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005475/JAW.

From 16. European conference on controlled fusion and plasma physics; Venice, Italy (13 Mar 1989).

The 0.67 m radius mesh flux conserver (MFC) in CTX was replaced by a solid flux conserver (SFC), resulting in greatly reduced field errors. Decreased spheromak open flux led to vastly improved decaying discharges, including increased global energy confinement times {tau}/sub E/ (from 20 to 180 μs) and corresponding magnetic energy decay times {tau}/sub B{sup 2}/ (from 0.7 to 2 ms). Improved confinement allowed the observation of a pressure-driven instability which ejects plasma from the spheromak interior to the wall. 9 refs., 3 figs.

16728 **(LBL—25540) Abstracts submitted for the thirtieth annual meeting, Division of Plasma Physics.** (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 23p. (CONF-881041—Absts.). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004701/JAW.

From 30. annual meeting of the American Physical Society Division of Plasma Physics; Hollywood, FL, USA (30 Oct 1988).

This paper contains abstracts presented at the 13th annual meeting of the American Physical Society, Division of Plasma Physics. (LSP)

16729 **(LRP—310/86) 1987 International conference on plasma physics.** (Chalmers Univ. of Tech., Goeteborg (Sweden)). Dec 1986. 20p. (CONF-8704170—5). NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89006541/JAW.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

This report contains plasma physics papers on the following topics: energy transfer from standing waves to gyrating particles; global waves in the ICRF in JET plasmas; and HFS and LFS scenarii for ICRF heating in JET. This report contains 3 related papers that have been indexed elsewhere. (LSP)

16730 **(LRP—320/87) 1987 international conference on plasma physics.** (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Apr 1987. 33p. (CONF-8704170—6). NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89006540/JAW.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

This report discusses topics in plasma physics on the following :Intrinsic strochasticity of plasma ions in electrostatic waves; finite amplitude electrostatic waves; and evolution of electrostatic waves and beams distribution function in a beam plasma system. (LSP)

16731 **(LRP—321/87) Low Frequency rf heating and TCA using Alfven Waves.** Appert, K.; Besson, G.; Borg, G.G.; Duval, B.P.; Howling, A.A.; Joye, B.; Lister, J.B.; Moret, J.-M.; Ryter, F.; Vaclavik, J.; Weisen, H. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Apr 1987. 25p. (CONF-8704170—7). NTIS (US Sales Only), PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006539/JAW.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

We present some new results on the excitation of Alfven Waves in the TCA tokamak, including properties of the external rf wavefield which are indicative of the importance of kinetic effects, and observations of the internal fluctuations for travelling waves. A parametric analysis of the density rise is used to quantify its evolution when the rf power is applied and when the excited spectrum changes. Changes in the excited spectrum also provoke variations in the plasma equilibrium, in the column resistance and in the MHD activity. The variations in β/sub perpendicular/ and β + li/2 are presented together with preliminary results from rf power modulation experiments. 22 refs., 22 figs.

16732 **(LRP—328/87) MHD equilibrium and stability of axisymmetric plasmas in the presence of rotation.** Bhattacharjee, A. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Aug 1987. 23p. (CONF-8708272—1). NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89006538/JAW.

From Workshop on theory of fusion plasmas; Varenna, Italy (24 Aug 1987).

In this paper, we review some recent developments in the ideal MHD equilibrium and stability theory of axisymmetric plasmas with flow. In tokamaks heated by neutral beams, such as ISX-B, PDX and more recently, TFTR and JET, plasma rotation of the order of the sound speed has been observed. The reported data pertains to purely toroidal rotation. However, when neutral beams are co-injected in TFTR, there are indications that poloidal flows can occur. It has also been recently suggested that strong electric fields can drive poloidal flows in the outer region of tokamaks such as PDX and ASDEX, and that these flows can play an important role in determining the characteristics of the H-mode observed in these devices. Apart from the experimental observations cited above, motivation for some of the studies reported in this paper has come from the Second Regime Experiment (SRX) jointly proposed by Columbia University and Grumman Corporation. Plasma rotation has been proposed as a possible technique for access to the second regime of stability in SRX. Our understanding of plasmas with flows is far from complete, in spite of the fact there exists an extensive literature on different aspects of this problem in astrophysics, fusion and space plasma physics. In the present review, we will concentrate on axisymmetric plasmas, with emphasis on tokamaks. 52 refs., 2 figs.

16733 **(LRP—335/87) Disruptions in tokamaks.** Bondeson, A. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Aug 1987. 23p. (CONF-8708272—2). NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep. Order Number DE89006536/JAW.

From Workshop on theory of fusion plasmas; Varenna, Italy (24 Aug 1987).

This paper discusses major and minor disruptions in tokamaks. A number of models and numerical simulations of disruptions based on resistive MHD are reviewed. A discussion is given of how disruptive current profiles are correlated with the experimentally known operational limits in density and current. It is argued that the q/sub a/ = 2 limit is connected with stabilization of the m = 2/n = 1 tearing mode for 2 < q/sub a/ {approx←lt} 2.7 by resistive walls and mode rotation. Experimental and theoretical observations indicate that major disruptions usually occur in at least two phases, first a "predisruption", or loss of confinement in the region 1 < q < 2, leaving the q ≅ 1 region almost unaffected, followed by a final disruption of the central part, interpreted here as a toroidal n = 1 external kink mode. 68 refs., 5 figs.

16734 **(PPPL—2555) Soft x-ray tomography on TFTR.** Kuo-Petravic, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1988. Contract AC02-76CH03073. 35p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006858/JAW.

The tomographic method used for deriving soft x-ray local emissivities on TFTR, using one horizontal array of 60 soft x-ray detectors, is described. This method, which is based on inversion of Fourier components and subsequent reconstruction, has been applied to the study of a sawtooth crash. A flattening in the soft x-ray profile, which we interpret as an m = 1 island, is clearly visible during the precursor phase and its location and width correlate well with those from electron temperature profiles reconstructed from electron cyclotron emission measurement. The limitations of the Fourier method, due notably to the aperiodic nature of the signals in the fast crash phase and the difficulty of obtaining accurately the higher Fourier harmonics, are discussed. 9 refs., 13 figs.

16735 **(PPPL—2556) 2-D time evolution of T/sub e/ during sawtooth crash based on fast ECE [electron cyclotron emission] measurements on TFTR.** Kuo-Petravic, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1988. Contract AC02-76CH03073. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006859/JAW.

Electron cyclotron emission measurements taken at 20 locations in the horizontal midplane during a sawtooth crash have been analysed based on the assumption of fast rigid rotation of the plasma. Due to this fast rotation (~100μsec), which remains fairly constant throughout the sawtooth crash, we have been able to make time-to-space reconstructions of half the poloidal plane using points which are separated in time by not more than 40μsec. The existence of a temperature flattening in the precursor phase, which we interpret as an m = 1 temperature island, is clearly demonstrated, and its location and width agree well with local emissivity measurements from soft x-ray tomography viewing the same poloidal plane. The rotating temperature island in the precursor phase, the outward movement of the region of high T/sub c/ during the crash phase, and the shape of T/sub e/ during the crash phase, and the shape of T/sub e/ distribution after the crash during the successor phase have all been documented in a time sequence of color contours. 4 refs., 10 figs.

16736 **(PPPL—2576) Scale length study in TFTR [Tokamak Fusion Test Reactor].** Hiroe, S.; Goldston, R.J.; Bitter, M.; Bush, C.E.; Efthimion, P.C.; Grek, B.; Johnson, D.W.; Murakami, M.; Schivell, J.; Towner, H.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1988. Contract AC02-76CH03073;AC05-84OR21400. 44p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006884/JAW.

The scale lengths of the electron density (L/sub n//sub e/), temperature (L/sub T//sub e/), and pressure (L/sub p//sub e/) gradients were investigated during the 1985 operating period of the Tokamak Fusion Test Reactor (TFTR) for gas-fueled plasmas with neutral beam injection and movable limiter. Although the global energy confinement time degrades as the heating power increases or the plasma current decreases, the radial profiles of the scale lengths (L/sub T//sub e/ and L/sup p//sub e/) remain unchanged. Especially, the electron pressure profile is constrained not to change. This trend appears to hold over a fairly wide range of TFTR operational regimes. The radial profiles of L/sub n//sub e/ and {eta}/sub e/ (= L/sub n//sub e//L/sub T//sub e/) also appear to remain unchanged, although the uncertainties of the experimental data for these quantities are greater than those for L/sub T//sub e/ and L/sub p//sub e/. The experimental parameters are used to evaluate theoretical predictions of the electron thermal diffusivity, and the results are compared with the empirical thermal diffusivity. 34 refs., 18 figs., 2 tabs.

16737 **(PPPL—2577) Sensitivity of transient synchrotron radiation to tokamak plasma parameters.** Fisch, N.J.; Kritz, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1988. Contract AC02-76CH03073. 37p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006883/JAW.

Synchrotron radiation from a hot plasma can inform on certain plasma parameters. The dependence on plasma parameters is particularly sensitive for the transient radiation response to a brief, deliberate, perturbation of hot plasma electrons. We investigate how such a radiation response can be used to diagnose a variety of plasma parameters in a tokamak. 18 refs., 13 figs.

16738 **(PPPL—2580) Theoretical studies of enhanced confinement properties in tokamaks.** Tang, W.M.; Bretz, N.L.; Hahm, T.S.; Lee, W.W.; Perkins, F.W.; Redi, M.H.; Rewoldt, G.; Zarnstorff, M.C.; Zweben, S.J.; Sydora, R.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006880/JAW.

In order to achieve the stated objectives of key future experiments such as CIT, it will be necessary to maintain plasmas with confinement properties significantly improved over those observed in auxiliary-heated L-mode-type tokamak discharges. This underscores the importance of understanding the physics responsible for the favorable trends exhibited, for example, by "supershot" discharges in TFTR and by H-mode-type divertor plasmas. In addressing this general issue, the present paper reports results of theoretical investigations dealing with: the onset conditions of the microinstabilities most likely to influence enhanced confinement behavior; gyrokinetic particle simulations and analytic studies of the saturation and transport properties of the most persistent forms of these instabilities; and detailed comparisons of experimental results with predictions from transport codes using appropriate microinstability-based diffusivities and with local diffusivities from various theoretical models. 19 refs., 2 tabs.

16739 **(PPPL—2581) Theory of energetic/alpha particle effects on magnetohydrodynamic modes in tokamaks.** Chen, L.; White, R.B.; Rewoldt, G.; Colestock, P.; Rutherford, P.H.; Chen, Y.P.; Ke, F.J.; Tsai, S.T.; Bussac, M.N. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006879/JAW.

The presence of energetic particles is shown to qualitatively modify the stability properties of ideal as well as resistive magnetohydrodynamic (MHD) modes in tokamaks. Specifically, we demonstrate that, consistent with highpower ICRF heating experiments in JET, high energy trapped particles can effectively stabilize the sawtooth mode, providing a possible route to stable high current tokamak operation. An alternative stabilization scheme employing barely circulating energetic particles is also proposed. Finally, we present analytical and numerical studies on the excitations of high-n MHD modes via transit resonances with circulating alpha particles. 14 refs., 3 figs.

16740 **(PPPL—2582) Pitch angle resolved measurements of escaping charged fusion products in TFTR.** Zweben, S.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006878/JAW.

Measurements of the flux of charged fusion products escaping from the TFTR plasma have been made with a new type of detector which can resolve the particle flux vs. pitch angle, energy, and time. The design of this detector is described, and results from the 1987 TFTR run are presented. These results are roughly consistent with predictions from a simple first-orbit particle loss model with respect to the pitch angle, energy, time, and plasma current dependence of the signals. 11 refs., 9 figs.

16741 **(PPPL—2583) Ion Bernstein wave heating on the Compact Ignition Tokamak (CIT).** Ignat, D.W.; Ono, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006877/JAW.

In the present plan, CIT is to be heated by power in the ion cyclotron range of frequencies (ICRF), and electron cyclotron heating (ECH) may be used if suitable rf sources can be developed. We consider the option of ion Bernstein wave heating (IBWH). The key points are that a simple vacuum waveguide launcher can be well- removed from high fluxes of heat and particles and that the development of a suitable source is straightforward. A practical point is that an IBWH waveguide launcher, including transition from coaxial power feeds, fits inside the shield wall surrounding CIT. To confirm IBWH as an option for CIT, experiments are needed on a shaped, H-mode plasma at high power. Successful experiments should be followed by a tube development program to allow CIT heating at 200 - 275 MHz. 2 refs., 3 figs.

16742 **(PPPL—2584) The Compact Ignition Tokamak and electron cyclotron heating: Description of need; assessment of prospects.** Ignat, D.W.; Cohn, D.R.; Woskov, P.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 41p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89006876/JAW.

The CIT will benefit from auxiliary heating of 10 to 40 MW. The schedules of both the CIT construction project and the operating plan contain adequate time to develop and implement ECH systems based on the gyrotron and the induction free electron laser (IFEL). Each approach has advantages and is the object of R and D at the level of many millions of dollars per year. While the gyrotron is further advanced in terms of power and pulse length achieved, rapid progress is scheduled for the IFEL, including experiments on tokamaks. Plans of CIT, gyrotron, and IFEL make 1992 an appropriate time frame to commit to one or both systems. 12 refs., 8 figs., 2 tabs.

16743 **(PPPL—2585) Toroidal Alfven wave stability in ignited tokamaks.** Cheng, C.Z.; Fu, G.Y.; Van Dam, J.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89006875/JAW.

The effects of fusion-product alpha particles on the stability of global-type shear Alfven waves in an ignited tokamak plasma are investigated in toroidal geometry. Finite toroidicity can lead to stabilization of the global Alfven eigenmodes, but it induces a new global shear Alfven eigenmodes, which is strongly destabilized via transit resonance with alpha particles. 8 refs., 2 figs.

16744 **(PPPL—2587) Nonambipolarity, orthogonal conductivity, poloidal flow, and torque.** Hulbert, G.W.; Perkins, F.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006873/JAW.

Nonambipolar processes, such as neutral injection onto trapped orbits or ripple-diffusion loss of α-particles, act to charge a plasma. A current j/sub r/ across magnetic surfaces must arise in the bulk plasma to maintain charge neutrality. An axisymmetric, neoclassical model of the bulk plasma shows that these currents are carried by the ions and exert a j/sub r/B/sub θ/R/c torque in the toroidal direction. A driven poloidal flow V/sub θ/ = E/sub r/"c/B must also develop. The average current density <j/sub r/> is related to the radial electric field E/sub r/' = E/sub r/ + v/sub {phi}/B/sub θ//c in a frame moving with the plasma via the orthogonal conductivity <j/sub r/> = σ/sub {perpendicular}/E/sub r/', which has the value σ/sub {perpendicular}/ = (1.65ϵ/sup 1/2/)(ne^2ν/sub ii//MΩ/sub θ/^{2}) in the banana regime. If an ignited plasma loses an appreciable fraction Δ of its thermonuclear α-particles by banana ripple diffusion, then the torque will spin the plasma to sonic rotation in a time {tau}/sub s/ $\sim$ 2{tau}/sub E//Δ, {tau}/sub E/ being the energy confinement time. 10 refs., 1 fig.

16745 **(PPPL—2588) Investigations of multiphoton excitation and ionization in a short range potential.** Susskind, S.M.; Cowley, S.C.; Valeo, E.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 12p. (CONF-880904—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006872/JAW.

From 4. topical meeting on short wavelength coherent radiation: generation and applications; Cape Cod, MA, USA (26 Sep 1988).

We introduce an approach to the study of excitation and ionization for a system with a short range potential. In particular, analytical and numerical results are presented for the multiphoton ionization rate, under strong field conditions, of an electron confined by a δ-function potential. 9 refs., 3 figs.

16746 **(PPPL—2589) A simplified model of nuclear heating in tokamaks.** Kessel, C.E.; Liew, S.L.; Ku, L.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 47p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006871/JAW.

The determination of the distribution of heating in fusion devices is important for thermo-mechanical design and analysis. The nuclear heating is a component of the total heating and is the concern of this paper. For toroidal geometries, such as a tokamak, this is difficult to approximate using simple models, and typically requires a two-dimensional neutron-gamma transport calculation. The particular problem is to incorporate the poloidal variation of the heating. A simplified model is developed to approximate the nuclear heating as a function of the poloidal angle and depth into the structure of interest. The technique uses ray-tracing and one-dimensional neutron-gamma transport calculations. This method has great advantage over the multidimensional neutron-gamma transport calculations, particularly for a frequently changing design. The 1.75 m Compact Ignition Tokamak (CIT) design is used as an example, and comparisons with two-dimensional results are given. 8 refs., 17 figs., 2 tabs.

16747 **(PPPL—2590) Calculation of the absolute detection efficiency of a moderated ^{235}U neutron detector on the Tokamak Fusion Test Reactor.** Ku, L.P.; Hendel, H.W.; Liew, S.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006870/JAW.

Neutron transport simulations have been carried out to calculate the absolute detection efficiency of a moderated ^{235}U neutron detector which is used on the TFTR as a part of the primary fission detector diagnostic system for measuring fusion power yields. Transport simulations provide a means by which the effects of variations in various shielding and geometrical parameters can be explored. These effects are difficult to study in calibration experiments. The calculational model, benchmarked against measurements, can be used to complement future detector calibrations, when the high level of radioactivity resulting from machine operation may severely restrict access to the tokamak. We present a coupled forward-adjoint algorithm, employing both the deterministic and Monte Carlo sampling methods, to model the neutron transport in the complex tokamak and detector geometries. Sensitivities of the detector response to the major and minor radii, and angular anisotropy of the neutron emission are discussed. A semi-empirical model based on matching the calculational results with a small set of experiments produces good agreement (+-15%) for a wide range of source energies and geometries. 20 refs., 6 figs., 4 tabs.

16748 **(PPPL--2592) A new asymmetric Abel-inversion method for plasma interferometry in tokamaks.** Park, H.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1989. Contract AC02-76CH03073. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006868/JAW.

In order to get precise local electron density information from chordal interferometric measurement of a tokamak plasma, a self- consistent and reliable inversion method is necessary. In this paper, a new asymmetric Abel-inversion method is introduced. This method includes flexible boundary conditions, application to a noncircular geometry, and estimation of the plasma in the scrape-off layer. The advantages of this method are demonstrated by comparison with other methods. This new inversion method is applied to a parametric study which includes dependence on the Shafranov shift and elongation of the profile. The inverted results are integrated along different views and compared with other density measurements. This new method can also be applied to plasma spectroscopy. 6 refs., 6 figs.

16749 **(UCRL—99062) High power induction free electron laser.** Miller, J.L. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 7p. (CONF-890154—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006208/JAW.

From Modeling and simulation of laser systems; Los Angeles, CA, USA (17 Jan 1989).

Free electron laser (FEL) amplifiers driven by linear induction accelerators have considerable potential for scaling to high average powers. The high electron beam current produces large single pass gain and extraction efficiency, resulting in high peak power. The pulse repetition frequency scaling is limited primarily by accelerator and pulsed power technology. Two FEL experiments have been performed by the Beam Research Program at the Lawrence Livermore National Laboratory (LLNL): The ELF experiment used the 3.5-MeV beam from the Experimental Test Accelerator (ETA) and operated at a wavelength of 8.6 mm. This device achieved an overall single-pass gain of 45 dB, an output power of 1.5 GW, and an extraction efficiency of 35%. The microwave beam was confined in a waveguide in the 4-m-long wiggler. The PALADIN experiment uses the 45-MeV beam from the Advanced Test Accelerator and operates at a wavelength of 10.6 μm. Using a 15-m long wiggler a single pass gain of 27 dB was produced. Gain guiding was observed to confine the amplified beam within a beam tube that had a Fresnel number less than 1. The results of these experiments have been successfully modeled using a three dimensional particle simulation code. The Program also has ongoing efforts to develop wiggler, pulsed power and induction linac technology. A focus of much of this work is the ETA-II accelerator, which incorporates magnetic pulse compression drivers. One application of ETA-II will be to drive a 1 mm wavelength FEL. The microwave output will be used for a plasma heating experiment. 15 refs., 4 figs.

16750 **(UNB-FIS—06/88) Plasma heating by two laser fields.** Fonseca, A.L.A.; Nunes, O.A.C.; Aragao, F.R.F. (Brasilia Univ., DF (Brazil). Dept. de Fisica). Jun 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705603/JAW.

The heating of a plasma by electrons in the simultaneous presence of weak and strong laser field by the inverse Bremsstrahlung process is considered from a quantum-mechanical viewpoint. A Kinetic equations is derived and the change in Kinetic energy of the plasma electrons is calculated. Results show that the joint action of the two laser beams gives a nonvanishing but large heating rate in the regime of high intensity of the strong field. A physical explanation for this behaviour is provided.

16751 **(UNB-FIS—07/88) Screening effect on the inverse bremsstrahlung in a plasma in the presence of two laser fields.** Nunes, O.A.C.; Fonseca, A.L.A. (Brasilia Univ., DF (Brazil). Dept. de Fisica). Jun 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705604/JAW.

The effect of Coulomb screening on the inverse bremsstrahlung heating process in a plasma illuminated by two laser fields is discussed. It is shown that, although the screening effect actually lowers the Coulomb interaction, one might accomplish a reduction of the weakening effect and consequently and enhancement of the collisional plasma heating, by illuminating the plasma with the two electromagnetic waves having a differnce in frequency close to the plasma frequency. (M.W.O.).

16752 **(X-EP-LPMI-RA—1985) Annual report of the Ionized Media Physics Laboratory, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 60p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756714/JAW.

Research on laser-matter interactions and compression of the target by the laser; plasma turbulence and stochasticity; the physics of intense electron and ion beams; and the physics of negative ions produced by hydrogen plasmas is presented.

16753 **(X-EP-LPMI-RA—1986) Annual report of the Ionized Media Physics Laboratory, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 69p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88756715/JAW.

Research on fluctuation and transport in magnetic fusion; non linear plasma physics; production and destruction of H/sup -/ and D/sup -/ ions in plasmas; coherent radiation of an intense relativistic electron beam and radiation of a hot plasma produced by z-pinch; the atomic physics and X-ray spectroscopy of hot plasmas; and fluid simulation of hot plasmas is presented.

16754 **Hydrodynamic model of plasma initiation off irradiated metallic aerosols in vacuum: The diffusive regime.** Chitanvis, S.M. (Los Alamos National Laboratory, Theoretical Division, K723, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **65**: No. 5, 1838-1845(1 Mar 1989).

We exploit the analogy between chemical reactions and cascade ionization to study the spatial and temporal dynamics of plasma formation in the vapor that is formed off a metallic aerosol that is being irradiated by a high-energy laser beam, in vacuum. Our hydrodynamic model is valid for relatively low laser fluences (10^3 J/cm^2 for aluminum aerosols) and pulses of the order of nanoseconds or less, when the diffusive approximation may be safely invoked. The main result of our paper is to show that the laser-induced plasma layer around aerosols shows a crossover, from being transparent to being opaque, as the fluence incident upon the aerosol is increased. We use our model of cascade ionization to show that for the laser fluxes for which the model is valid, the plasma in the vapor layer surrounding an aluminum metallic sphere is not dense enough to obscure the laser beam. But for flux levels of 10/ sup 11/ W/cm^2 or higher and pulse lengths of 10 ns or longer, the plasma around individual aluminum aerosols becomes very absorbing.

16755 **Diffusive processes in the cross-field flow of intense plasma beams.** Newberger, B.; Rostoker, N. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Journal of Applied Physics;* **65**: No. 5, 1874-1879(1 Mar 1989).

We consider magnetic field diffusion in the presence of strongly magnetized electrons (ω/sub c//sub e/tau/sub c//sub / $_0$>1) as a mechanism for the rapid penetration observed in cross-field flows of high-β plasma beams. The diffusion has been investigated in several cases which are amenable to analytic solution. The flux penetration times are found to be insensitive to the particular configuration. Comparison with two experiments is made. Agreement within the limits of the experiments is found. Both require an anomalous collision rate which is consistent with observed fluctuations in one case but apparently not the other.

16756 **New tilted-poles Wien filter with enhanced performance.** Leal-Quiros, E.; Prelas, M.A. (Fusion Research Laboratory, Nuclear Engineering Program, University of Missouri-Columbia, Columbia, Missouri 65211). *Review of Scientific Instruments;* **60**: No. 3, 350-357(Mar 1989).

The Wien filter is an E x B deflecting analyzer with the electrostatic field perpendicular to the magnetostatic field. The twofold functions of the Wien filter are as an energy analyzer as well as a mass analyzer. It has very high resolution for paraxial charged-particle beams with V = E/B, the Wien velocity. Two Wien filters, a tilted-poles Wien filter, and a classical parallel-rectangular-poles Wien filter were built and tested for electrons up to 3.5 keV and protons beams of 200 eV. (The tilted-poles Wien filter is a new diagnostic developed by the authors.) The performance of the two is compared, and the tilted-poles Wien filter has superior resolution to the classical Wien filter. Both Wien filters appear to have features useful for high-temperature plasma diagnostics, including simultaneous measurement of energy and mass spectra, and high resolution.

16757 **X-ray framing camera for picosecond imaging of laser-produced plasmas.** Stearns, D.G.; Wiedwald, J.D.; Cook, B.M.; Hanks, R.L.; Landen, O.L. (University of California, Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, California 94550). *Review of Scientific Instruments;* **60**: No. 3, 363-367(Mar 1989).

We describe the development and characterization of an ultrafast x-ray framing camera capable of recording images with a temporal resolution of 50 ps and spatial resolution of 22 μm at the image plane. The unique design incorporates an x-ray photocathode directly into a suspended-strip transmission line. The photocathode is gated using a high-voltage (-5-kV) pulse of short duration generated with a photoconductive switch. The photoelectrons are extracted through an unbiased microchannel plate and are directly detected with a charge-coupled device in the electron-bombardment mode. We discuss applications of the camera to investigate the dynamics of laser-produced plasmas.

16758 **Three-dimensional plasma equilibrium near a separatrix.** Reiman, A.H.; Pomphrey, N.; Boozer, A.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 555-562(Mar 1989).

The limiting behavior of a general three-dimensional magnetohydrodynamic (MHD) equilibrium near a separatrix is calculated explicitly. No expansions in beta or assumptions about island widths are made. Implications of the results for the numerical calculation of such equilibria are discussed, as well as for issues concerning the existence of three-dimensional MHD equilibria.

16759 **Experimental study of the hot electron plasma equilibrium in a minimum-B magnetic mirror.** Chen, X.; Lane, B.G.; Smatlak, D.L.; Post, R.S.; Hokin, S.A. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 615-628(Mar 1989).

The Constance B mirror [in Plasma Physics and Controlled Nuclear Fusion Research 1984 (IAEA, Vienna, 1985), Vol. II, p. 285] is a single cell quadrupole magnetic mirror in which high-beta (typically 0.3), hot electron plasmas (T/sub e/≃400 keV) are created with up to 4 kW of fundamental electron cyclotron resonance heating (ECRH). Details of the plasma equilibrium profile are quantitatively determined by fitting model plasma pressure profiles to the data from four complementary measurements: diamagnetic loops and magnetic probes, x-ray pinhole cameras, visible light TV cameras, and thermocouple probes. The experimental analysis shows that the equilibrium pressure profile of an ECRH generated plasma in a baseball magnetic mirror is hollow and the plasma is concentrated along a baseball-seam-shaped curve. The hollowness of the hot electron density profile is 50% +- 10%. The baseball-seam-shaped equilibrium profile coincides with the drift orbit of deeply trapped electrons in the quadrupole mirror field. Particle drift reversal is predicted to occur for the model pressure profile that best fits the experimental data under the typical operating conditions.

16760 **Drift wave vortices and anomalous transport.** Horton, W. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 524-537(Mar 1989).

Theory and computer simulations are used to describe the inelastic vortex—vortex and vortex—wave interactions that lead to the quasicoherent transport of plasma across a constant magnetic field in 2-D systems. Monopole and dipole drift wave vortices with radii r_0 large compared with the ion inertial scale length rho/sub s/ are shown to produce transport at the rate un $\int d\sigma(b) \leqq n/\text{sub } v/ v/\text{sub } d//\text{sub } e/r_0$, where n/sub v/ is the vortex line density and $d\sigma(b)$ is the inelastic collision cross section for the impact parameter b. The transport during collisions and mergings is evaluated from the evolution of a passively convected scalar concentration of test particles.

16761 **Orbit effects on impurity transport in a rotating tokamak plasma.** Wong, K.L.; Cheng, C.Z. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08543). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 545-554(Mar 1989).

Particle orbits in a rotating tokamak plasma are calculated from the equation of motion in the frame that rotates with the plasma. It is found that heavy particles in a rotating plasma can drift away from magnetic surfaces significantly faster with a higher bounce frequency, resulting in a diffusion coefficient much larger than that for a stationary plasma. Particle orbits near the surface of a rotating tokamak are also analyzed. Orbit effects indicate that more impurities can penetrate into a plasma rotating with counter-beam injection. Particle simulation is carried out with realistic experimental parameters and the results are in qualitative agreement with some experimental observations in the Tokamak Fusion Test Reactor (TFTR) [in Proceedings of the 14th European Conference on Controlled Fusion and Plasma Heating (European Physical Society, Brussels, 1987), p. 121].

16762 **Variational bounds for transport coefficients in three-dimensional toroidal plasmas.** van Rij, W.I.; Hirshman, S.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 563-569(Mar 1989).

A variational principle is developed for the linearized drift-kinetic, Fokker—Planck equation, from which both upper and lower bounds for neoclassical transport coefficients can be calculated for plasmas in three-dimensional toroidal confinement geometries. These bounds converge monotonically with the increasing phase-space dimensionality of the assumed trial function. This property may be used to identify those portions of phase space that make dominant contributions to the transport process. A computer code based on this principle has been developed that uses Fourier—Legendre expansions for the poloidal, toroidal, and pitch-angle dependences of the distribution function. Numerical calculations of transport coefficients for a plasma in the TJ-II flexible heliac [Nucl. Fusion 28, 157 (1988)] are used to demonstrate the application of this procedure.

16763 **Relaxation rate of poloidal rotation in the banana regime in tokamaks.** Shaing, K.C.; Hirshman, S.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 705-707(Mar 1989).

The relaxation rate ν/sub p/ of poloidal rotation in the banana regime in tokamaks is calculated using a time-dependent parallel viscosity. It is found that ν/sub p/ is on the order of ν/sub i//sub i/, the ion—ion collision frequency, with no geometric enhancement factor associated with toroidicity.

16764 **Observation of trapped particle modes in a tandem mirror.** Gerver, M.J.; Golovato, S.N.; Irby, J.H.; Kesner, J.; Casey, J.A.; Guss, W.C.; Horne, S.F.; Lane, B.G.; Machuzak, J.S.; Post, R.S.; and others. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 608-614(Mar 1989).

An instability with azimuthal mode number $m \geqq 3$ localized to an axisymmetric end cell of the Tara tandem mirror [Nucl. Fusion 22, 549 (1982)] has been observed, most prominently during strong ion cyclotron resonance heating in the end cell. The instability, which causes enhanced radial losses, becomes either more stable or flutelike when the connection (passing fraction) between the central cell and end cell is increased, depending on whether sufficient stabilization is provided in the central cell. The beta is sufficiently low to rule out the possibility of magnetohydrodynamic ballooning modes. Based on the plasma parameters, the instability appears to be a collisionless curvature-driven trapped particle mode that has been predicted to be unstable in linked minimum- and maximum-B mirror devices.

16765 **Ballooning modes in an axisymmetric mirror machine.** Close, R.A.; Lichtenberg, A.J. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 629-634(Mar 1989).

High-beta ballooning modes are studied in an axisymmetric multiple mirror which is made average-minimum B with end cusps. Electric and magnetic field measurements in the plasma characterize the predominant azimuthal mode number as $m = 1$. The ballooning character of the mode is determined by measuring the ratio of the mode amplitude near the device center to that near the cusp, and confirmed by measurement of perturbed perpendicular magnetic fields. Theoretical growth rates are calculated numerically using ideal and resistive magnetohydrodynamic (MHD) equations for the rigid $m = 1$ ballooning mode. Within experimental error it is found that the $m = 1$ resistive ballooning growth rate scales with radially averaged beta $< \beta >$ approximately as $< \beta >^{1}$/sup //^{2} for $< \beta >$approx. <0.10 (on axis $\beta_0$approx. <0.20), in agreement with theory. The observed growth rates increase with mirror ratio as expected. The resistive growth rates calculated numerically agree reasonably well with experimental observations.

16766 **Energy deposition and shock wave evolution from laser-generated plasma expansions.** MacFarlane, J.J.; Moses, G.A.; Peterson, R.R. (Fusion Technology Institute, Department of Nuclear Engineering and Engineering Physics, University of Wisconsin: Madison, Madison, Wisconsin 53706-1687). *Physics of Fluids B: Plasma Physics;* **1**: No. 3, 635-643(Mar 1989).

One-dimensional radiation-hydrodynamics calculations have been performed to study the structure and evolution of blast waves resulting from laser-generated plasma expansions. The results are compared with experimental data obtained at the Naval Research Laboratory [Laser Interaction and Related Plasma Phenomena (Plenum, New York, 1986), Vol. 7, pp. 857—877]. In these calculations, target ions expand into a stationary background gas with an initial pressure ranging from 25 mTorr—5 Torr. Because the stopping ranges of the target ions are comparable to the dimensions of the shock, the blast wave properties are sensitive to the ion stopping cross sections. In some calculations, the effects of radiation transport were neglected in order to assess its importance. The results presented in this paper are in generally good agreement with available experimental data, and indicate that the observed blast wave properties can be accounted for by using a classical collision model to describe the interaction between the target ions and the background plasma.

16767 **Kelvin-Helmholtz vortex formation and particle transport in a cross-field plasma sheath.** Theilhaber, K.; Birdsall, C.K. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **62**: No. 7, 772-775(13 Feb 1989).

The time-dependent behavior of a magnetized, two-dimensional plasma-wall sheath has been studied through particle simulations, whcih have shown that the cross-field sheath develops into a turbulent boundary layer, driven by the Kelvin-Helmholtz instability. The sheath acquires an equilibrium thickness l/sub x/$\sim$5rho/sub i/, and maintains long-lived vortices, with amplitudes δphi$\sim$-2T/sub i//e, which drift parallel to the wall at half the ion thermal velocity. A central simulation result is that for ω/sub π/$\geqq$2ω/sub ci/, the anomalous particle transport in the sheath scales like Bohn diffusion.

16768 **Reduction of Raman scattering in a plasma to convective levels using induced spatial incoherence.** Obenschain, S.P.; Pawley, C.J.; Mostovych, A.N.; Stamper, J.A.; Gardner, J.H.; Schmitt, A.J.; Bodner, S.E. (U. S. Naval Research Laboratory, Washington, D.C. 20375). *Physical Review Letters;* **62**: No. 7, 768-771(13 Feb 1989).

We present measurements of the Raman backscatter produced by laser-plasma interaction where the laser focal profile was smoothed by induced spatial incoherence (ISI). The Raman backscatter with the ISI beam is much smaller than that with an ordinary beam. The onset of Raman backscattering with ISI followed the predictions of a convective gain model to within 30% in intensity.

16769 **Experimental measurement of nonlinear plasma wake fields.** Rosenzweig, J.B.; Schoessow, P.; Cole, B.; Gai, W.; Konecny, R.; Norem, J.; Simpson, J. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] A: General Physics;* **39**: No. 3, 1586-1589(1 Feb 1989).

We report direct high-resolution observation of nonlinear steepened plasma waves excited in the wake of an intense, self-pinched electron beam. Oscillations in both accelerating and deflecting fields are measured, and analyzed in the context of linear and nonlinear plasma wave theory. The degree of nonlinearity in the wake fields is shown to be consistent with analytical predictions of the beam self-pinching. The impact of these results on plasma acceleration and focusing schemes is discussed.

16770 **High-β, sawtooth-free tokamak operation using energetic trapped particles.** White, R.B.; Bussac, M.N.; Romanelli, F. (Princeton Plasma Physics Laboratory, P.O. Box 451, Princeton, New Jersey 08543). *Physical Review Letters;* **62**: No. 5, 539-542(30 Jan 1989).

It is shown that a population of high-energy trapped particles, such as that produced by ion cyclotron heating in tokamaks, can result in a plasma completely stable to both sawtooth oscillations and the fishbone mode. The stable window of operation increases in size with plasma temperature and with trapped particle energy, and provides a means of obtaining a stable plasma with high current and high β.

16771 **Tokamak magnetic turbulence over the safety-factor range $0.6<q<3$.** Graessle, D.E.; Prager, S.C.; Dexter, R.N. (Department of Physics, University of Wisconsin—Madison, Madison, Wisconsin 53706). *Physical Review Letters;* **62**: No. 5, 535-538(30 Jan 1989).

Magnetic turbulence ($\nu<400$ kHz) has been measured both internal and external to a tokamak plasma as the edge q is varied from 0.6 to 3. The radial and poloidal spatial dependences of the coherence are investigated. The spatial and frequency dependences of the fluctuaions are similar over the wide range of q.

16772 **Power dependence of electron-cyclotron current drive for low- and high-field absorption in tokamaks.** Harvey, R.W.; McCoy, M.G.; Kerbel, G.D. (General Atomics, San Diego, California 92138). *Physical Review Letters;* **62**: No. 4, 426-429(23 Jan 1989).

A new relativistic, bounce-averaged Fokker-Planck—quasi-linear code shows that for experimentally relevant rf power p/sub rf/(W/cm^3) /[n/sub e/(10/sup 13/ cm/sup -3/)]^{2}approx. >0.5, electron-cyclotron current-drive efficiency (absorptivity) is power dependent; at given plasma radius the current-drive efficiency increases above linear values for absorption of the rf on the low-field side of the cyclotron resonance layer, but decreases and even passes through zero for absorption on the high-field side. Thus, electron-cyclotron current-drive by high-field launch will generally not be suitable.

16773 **First direct measurement of α-μ sticking in dt-μCF.** Paciotti, M.A.; Baker, O.K.; Bradbury, J.N.; Cohen, J.S.; Leon, M.; Maltrud, H.R.; Sturgess, L.L.; Jones, S.E.; Li, P.; Rees, L.M.; and others. (Los Alamos National Laboratory, Los Alamos, N.M.). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 38-51(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

Both $(\alpha\mu)^+$ and α particles have been observed in coincidence with fusion neutrons in a gaseous D-T target at 2.8×10^{-3} liquid-hydrogen density. The initial muon sticking probability in muon-catalyzed d-t fusion, measured directly for the first time, is (0.80 +- 0.15 +- 0.12 systematic)% in agreement with 'standard' theoretical calculations. However, this measured value does not support those theories that invoke special mechanisms to alter the initial sticking value.

16774 **μ CF thoughts from Birmingham and the Rutherford Appleton Laboratory.** Davies, J.D.; Brooks, F.D.; Cilliers, W.A.; England, J.B.A.; Pyle, G.J.; Squier, G.T.A.; Bertin, A.; Bruschi, M.; Piccinini, M.; Vitale, A.; and others. (University of Birmingham, U.K.). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 52-56(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

This paper gives some ideas to be learnt from magnetic confinement fusion and briefly describes the pulsed muon beam at ISIS, progress with the measurement of W/sub s/ (the $\mu\alpha$ sticking coefficient), future beam plans and possible experiments.

16775 **Theoretical survey of μCF.** Leon, M. (Los Alamos National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 94-104(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

This report is an introduction to the theory of muon-catalyzed fusion. It will focus on the d-t fusion cycle. Three-body molecular formation, the deexitation cascade from the initial atomic capture of the μ^- to the ground state dμ or tμ, strong interaction effects, relativistic corrections to dtμ and ddμ binding energies, elastic scattering, hyperfine quenching, and d→ transfer reaction are all considered in this report. (AIP)

16776 **Possible influence of vacuum polarization on Q_1/ sub //sub s/ in muon catalyzed D-T fusion.** Mueller, B.; Rafelski, J.; Jaendel, M.; Jones, S.E. (Dept. of Physics, University of Arizona, Tucson, AZ 85721). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 105-110(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The vacuum polarization splitting of the M-shell states in muonic hydrogen can have a profound influence on the muonit de-excitation cascade in deuterium and tritium targets. The cascade also shows sensitive dependence on the precise rate of transfer processes between certain excited muonic deuterium and tritium atoms. Recent experimental data, where a much greater population of the (dμ) qs state (1_1/sub //sub s/) was found than previously predicted, can be explained if the transfer rates from the (dμ) M-shell are assumed to be strongly suppressed.

16777 **Pressure broadening of the [(dtμ)dee]* formation resonances.** Cohen, J.S.; Leon, M.; Padial, N.T. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 111-123(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The treatment of [(dtμ)dee]* formation at high densities as a pressure broadening process is discussed. Cross sections for collisions of the complex (dtμ)dee, and of the D_2 molecule from which it is formed, with the bath molecules have been accurately calculated. These cross sections are used to calculate the collisional width in three variations of the impact approximation that have been proposed for this problem. In general, the quasistatic approximation is shown to satisfy the usual conditions of muon-catalyzed fusion better than does the impact approximation. A preliminary rough treatment is presented to illustrate the quasistatic approximation.

16778 **Muonic molecular formation under laser irradiation and in the clustered ion molecule (The effect of protonium additive on the muon catalyzed fusion cycle).** Takahashi, H. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 185-198(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The fast resonance formation of the muonic molecule in muon-catalyzed fusion due to the shallow binding energy of (J = 1, v = 1) state produces more than 140 fusions per muon for a liquid

hydrogen density DT target. By using laser radiation the resonance formation can be increased. In this paper the enhancement of the dtμ formation rate by the strong laser irradiation is studied, taking into account the laser electron interaction. (AIP)

16779 **Considerations for μCF experiments with metastably spin-polarized D and T.** Honig, A.; Alexander, N.; Yucel, S. (Physics Department, Syracuse University, Syracuse, NY 13244). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 199-213(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

Highly spin-polarized D and T can be expected to modify muon catalyzed fusion (μCF) processes in important ways. Under appropriate conditions, the polarized reservoir induces repolarization of the muon during each fusion cycle, resulting in repeated selective hyperfine state occupation. The dependence of mesomolecular capture rates, cascading rates and fusion rates on spin (hyperfine state) can lead to different branchings in the evolutionary kinetics and possibly to modified fusion outcomes. In order to carry out most experiments on spin-dependence or to utilize polarized fuels, it is necessary for the polarized material to be removed from its production environment and retain its high polarization for a time period matched to the duration of the experiment. We describe here production of removable and transportable metastable highly spin-polarized D in HD and o-D_2, with polarization lifetime in the solid and liquid phase sufficient for application of μCF experiments. For spin-polarized DT, HT, and ortho-T_2, the polarization procedure, size of sample and duration of polariation are all less favorable than for D, and they have not as yet been developed to the extent of HD and D_2. Nevertheless, several usage modes for DT, HT+HD, and D_2+ortho-T_2 appear feasible for μCF, including both external usage variants and in situ experiments with the sample remaining within the dilution refrigerator. The latter relaxes the metastability requirement on the polarized tritons, but restricts the sample triton content to less than 1 Ci because of heat load from the triton beta decay.

16780 **Molecular effects in nuclear scattering: Hyperfine quenching in dμ+D_2 collisions.** Baker, O.K. (Los Alamos National Laboratory, Los Alamos, N.M. 87545). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 223-225(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

A better understanding of hyperfine effects in dμ scattering from molecules of hydrogen isotopes will be helpful in untangling the intricacies of the muon catalyzed fusion process. This paper presents calculations of hyperfine quenching cross sections and rates for dμ+D_2 scattering in the absence of [(ddμ)d2e] mesomolecular formation.

16781 **Capture of a classical muon by a quantal hydrogen atom.** Kwong, N.H.; Garcia, J.D.; Cohen, J.S. (Physics Department, University of Arizona Tucson, AZ 85721). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 236-238(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

Using a self-consistent method that treats the muon classically and the electron quantum mechanically, we have calculated the capture cross sections of μ- by atomic hydrogen at low incident energies.

16782 **Comparison of muonic molecular calculations.** Alexander, S.A.; Monkhorst, H.J.; Szalewicz, K. (Department of Physics, University of Florida Gainesville, Florida 32611). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 246-258(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

For the muonic molecular ions xyμ (x,y = p,d,t) we show that the difference in the binding energies of two calculations with different sets of particle masses converages quickly to a constant. Using these constants we discuss the relative efficiency of the different basis sets which have appeared in the literature.

16783 **Some properties of three body resonances of dtμ related to muon-catalyzed fusion.** Froelich, P.; Szalewicz, K.; Monkhorst, H.J.; Kolos, W.; Jeziorski, B. (Department of Quantum Chemistry Uppsala University Box 518, 75120 Uppsala, Sweden). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 259-273(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The recently discovered resonant states in the dtμ molecule are investigated, with emphasis on the properties related to the muon catalyzed fusion. For the lowest resonance of s-symmetry above the (dμ+t) threshold we have calculated the energy, life time, geometry, fusion rate, sticking fraction and collisional formation rate. The results are compared with the corresponding properties for the bound states. Also, estimations of muon cycling rates and the fusion yield have been obtained for the situation corresponding to resonantly enhanced fusion in flight.

16784 **Theoretical description of muonic molecular ions.** Szalewicz, K.; Alexander, S.A.; Froelich, P.; Haywood, S.E.; Jeziorski, B.; Kolos, W.; Monkhorst, H.J.; Scrinzi, A.; Stodden, C.; Velenik, A.; and others. (Department of Physics and Astronomy, University of Delaware, Newark, DE 19716). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 274-288(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

An accurate theoretical description of the muonic molecular ions is critical for understanding the phenomenon of muon catalyzed fusion. We review recent calculations on the tdμ ion which have substantially improved our knowledge of the processes involving this ion.

16785 **Comprehensive theory of nuclear effects on the intrinsic sticking probability: I.** Danos, M.; Biedenharn, L.C.; Stahlhofen, A. (National Bureau of Standards, Gaithersburg, MD 20899). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 308-319(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

A comprehensive, inherently many-body, reaction theory for an accurate calculation of the intrinsic sticking fraction, ω%/sub S/, for (dtμ) fusion is outlined. The non-perturbative treatment of the long-range Coulomb force and its interference with the short range nuclear force is emphasized.

16786 **Comprehensive theory of nuclear effects on the intrinsic sticking probability: II^{+}/sub +/.** Danos, M.; Biedenharn, L.C.; Stahlhofen, A. (National Bureau of Standards, Gaithersburg, MD 20899). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 320-329(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

An accurate calculation of the intrinsic sticking fraction, ω0/sub s/, for (dtμ) fusion requires the development of a comprehensive, non-perturbative, inherently many-body, reaction theory. We identify and discuss the key problems underlying our construction of this theory.

16787 **Boundary-value approach to nuclear effects in muon-catalyzed D-T fusion.** Hale, G.M.; Struensee, M.C.; Pack, R.T.; Cohen, J.S. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 344-354(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The use of boundary-matching techniques, as contained in R-matrix theory, to describe multichannel nuclear reactions is dis-

cussed. After giving a brief summary of the application of such techniques to the nuclear reactions in the ^{5}He system, we discuss a simple extension of the description to include muons, which was used to calculate nuclear effects on the L = 0 eigenvalues of the dtμ molucule in various adiabatic approximations. Next, the form of the outgoing naμ wavefunction is discussed, resulting in a new formulation of the amplitudes used to calculate the α—μ sticking fraction. Possible methods of solving for these amplitudes using the boundary-value approach are suggested, and some deficiencies of the "standard" expression for the sticking amplitudes are pointed out.

16788 **Density dependent stopping power and muon sticking in muon catalyzed D-T fusion.** Rafelski, H.E.; Mueller, B. (Department of Physics and Astrophysics, University of Cape Town, Rondebosch 7700, Cape, Town, RSA). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 355-366(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The origin of the experimentally observed [1] density dependence of the muon alpha sticking fraction ω/sub s/ in muon catalyzed deuterium- tritium fusion is investigated. We show that the reactivation probability depends sensitively on the target stopping power at low ion velocities. The density dependence of the stopping power for a singly charged projectile in liquid heavy hydrogen is parametrized to simulate possible screening effects and a density dependent effective ionization potential. We find that, in principle, a description of the measured density dependence is possible, but the required parameters appear too large. Also, the discrepancy with observed (Heμ) X-ray data widens.

16789 **Proposed method for reducing the sticking constant in M.C.F.** Kulsrud, R.M. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, New Jersey 08543). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 367-380(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

We present a method of reducing the effective sticking coefficient involving reacceleration of the Heμ ion by ion cyclotron resonance. It is necessary to work with the target D-T in solid or liquid form, and the target, has to be divided into many thin rods or pellets of order 100 microns in radius. The idea is to impose a magnetic field and a rotating electric field. A balance is achieved between drag in the rods or pellets and acceleration in the region in between, so that the Heμ ion is held at a constant velocity until stripping occurs. Although stripping is greatly reduced the idea is not practical, as it stands, because of the large alpha particle heat produced in the target.

16790 **Analytic solution for second-harmonic gyroresonant absorption and mode conversion.** Ye, H.; Kaufman, A.N. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 24, 2762-2765(12 Dec 1988).

An entirely analytic treatment for second-harmonic mode conversion is presented, which uses the wave-phase-space (x-k space) method. Explicit expressions are derived for the coefficients of transmission, reflection, conversion (magnetosonic wave to ion-Bernstein wave), and absorption. A conservation law for wave energy flux in phase space is also presented.

16791 **Simultaneous spectrally and spatially resolved measurements of 3ωX/2 emission from laser-produced plasmas.** Young, P.E.; Lasinski, B.F.; Kruer, W.L.; Williams, E.A.; Estabrook, K.G.; Campbell, E.M.; Drake, R.P.; Baldis, H.A. (University of California, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Physical Review Letters;* **61**: No. 24, 2766-2769(12 Dec 1988).

Measurements of three-halves harmonic emission from laser-produced plasmas are presented. The emission from molybdenum targets irradiated with 1.06-μm laser light is simultaneously spectrally and spatially resolved. The data show a clear spatial separation between the blue-shifted and red-shifted components of the three-halves emission. Spectral structure suggests that ion mode coupling is involved in the scattering process.

16792 **Quality assurance and R and D.** Howard, H.; Parsells, R. (Princeton Univ., Plasma Physics Lab., Princeton, NJ (US));. *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 429-431(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, United States (26 Jun 1988).

This paper is an overview of the Princeton Plasma Physics Laboratory (PPPL) Quality Assurance and Reliability program. It describes the Laboratory's research devices and its organization and characterizes the functional activities to establish the model to which the ASME/ANSI NQA - 1 - 1986 basic quality requirements have been tailored. The historical experience is presented in two discrete time phases that represent the pre - NQA - 1 and the NQA -1 eras. The basic concepts that have been developed and implemented are described. The implications of this experience for CIT are presented.

16793 **Short pulse X-ray diffraction studies of shocked and annealed crystals using the JANUS research laser.** Lee, R.W.; Eckart, M.J.; Kilkenny, J.D.; Whitlock, R.R.; Hauer, A.; Wark, J.S. (Lawrence Livermore National Lab., Livermore, CA (US));. pp v of X rays from laser plasmas. Richardson, M.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708233—).

From X-rays from laser plasmas; San Diego, CA, USA (19 Aug 1987).

When a crystal is annealed or shocked the spacing of the interatomic planes is altered, and a measurement of the lattice spacing can yield information on the temperature or compression respectively. The authors used the JANUS research laser at LLNL to perform such measurements of transiently strained crystals. JANUS is a two beam laser system, with separate synchronized oscillators for each beam. One beam of the laser, containing 10 - 100 J of 1.06μm light in a pulse of 1 ns FWHM, was focused to a 3.9 cm diameter spot on the surface of a silicon crystal; the crystal was either annealed or shock-compressed, depending on the absence or presence of a variety of thin coatings applied to the crystal surface. At some time during or after the perturbing pulse, the second synchronous but delayed laser beam, containing —10 J of 0.53μm light in a pulse of 100 ps (FWHM), was focused to a 40μm diameter spot onto a separate target containing calcium, potassium, and chlorine. Thus, a short pulse of the helium-like line radiation of these atoms was produced, and this radiation was Bragg diffracted from the surface of the strained crystal. Measurements of the change in Bragg angle, caused by thermal expansion or shock compression, gives a direct measurement of one component of the strain within the crystal. A single laser shot gives recordable x-ray levels. A number of shots at different irradiances and delay times gave information about the lattice spacing as a function of time. The potential applications of such results is discussed.

16794 **X-ray emission from high-Z spherical laser plasmas.** Cobble, J.A.; Hauer, A.; Stradling, G.; Mead, W.C.; Goldman, S.R.; Coggeshall, S.; Richardson, M.C.; Jaanimagi, P.A.; Barnouin, O.; Marjoribanks, R. (Los Alamos National Lab., Los Alamos, NM (US));. pp v of X rays from laser plasmas. Richardson, M.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708233—).

From X-rays from laser plasmas; San Diego, CA, USA (19 Aug 1987).

Conversion of 351-nm laser light to soft x-rays has been studied using spherical gold targets irradiated at 5 x 10/sup 12/-4 x 10/sup 15/ W/cm/sup 2/. Spectra and time histories of sub-keV and M-band emission are presented. Results have been compared to detailed models (LASNEX) to better determine the dynamics of the plasma processes which lead to x-ray emission.

16795 **Application of x-ray streak cameras for fusion diagnostics.** Jaanimagi, P.A.; Delettrez, J.; Gregory, G.G.; Marjoribanks, R.S.; Richardson, M.C.; Bradley, D.K.; Henke, B.L. (Lab. for Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY (US));. pp v of High speed photography, videography, and photonics V. Johnson, H.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8708231—).

From High speed photography, videography, and photonics V; San Diego, CA, USA (17 Aug 1987).

In this report the authors will review recent developments in our x-ray streak camera program. The characterization of the linearity and dynamic range of these diagnostics is vital for quantitative analysis of the data, which can then be compared to hydrocode simulations. Examples of time-resolved x-ray imaging and x-ray spectroscopy are presented to illustrate the current capabilities.

16796 **Fusion neutral-particle beam research and its contribution to SDI programs.** Haselton, H.H. (Plasma Technology Section, Fusion Energy Div., Oak Ridge National Lab. (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

The fusion program has developed a number of technologies with application to components of the Strategic Defense Initiative (SDI). Among these technologies are: plasma heating in fusion devices, using neutral-particle beams and radio-frequency (rf) heating; plasma fueling with frozen hydrogen isotopes, by mechanical and pneumatic methods; plasma edge technology, which involves particle handling, energy handling, and materials development; magnet development, which involves work with superconductors and cryogenics; and neutronics and diagnostics. The author focuses on the neutral-particle beam issues, with some discussion of other development areas and technologies that can be brought to bear on SDI.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 14470, 15125, 15400, 15678, 15679, 15693, 15785, 15791, 15897, 16529, 16712, 16779, 16792, 16793, 16796, 16796

16797 **(ANL/FPP/TM—231) Modeling of tritium behavior in ceramic breeder materials.** Kopasz, J.P.; Tam, S.W.; Johnson, C.E. (Argonne National Lab., IL (USA)). Nov 1988. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007049/JAW.

Computer models are being developed to predict tritium release from candidate ceramic breeder materials for fusion reactors. Early models regarded the complex process of tritium release as being rate limited by a single slow step, usually taken to be tritium diffusion. These models were unable to explain much of the experimental data. We have developed a more comprehensive model which considers diffusion and desorption from the grain surface. In developing this model we found that it was necessary to include the details of the surface phenomena in order to explain the results from recent tritium release experiments. A diffusion-desorption model with a desorption activation energy which is dependent on the surface coverage was developed. This model provided excellent agreement with the results from the CRITIC tritium release experiment. Since evidence suggests that other ceramic breeder materials have desorption activation energies which are dependent on surface coverage, it is important that these variations in activation energy be included in a model for tritium release. 17 refs., 12 figs.

16798 **(BNL—41997) Preliminary studies of an infrared free-electron laser oscillator at the ATF(BNL).** Gallardo, J.C. (Brookhaven National Lab., Upton, NY (USA)). 19 Oct 1988. Contract AC02-76CH00016. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006982/JAW.

In this report, I present results of a theoretical 1-D model discussed by G. Dattoli, A. Reniere and myself. The validity of a steady-state analysis is discussed and some estimates are given of the effects introduced by the "lethargy" of the laser pulse due to the finite length of the e/sup {minus}/ pulse. Also, I present analytical expressions for the laser pulse in terms of supermodes (wavepackets of cavity modes), their evolution, physical width as well as the associated frequency spectrum. Next, I present results obtained with a 3-D code for the single pass, small-signal gain. In the appendix, I summarize the symbols used in this report. 2 refs., 6 figs., 3 tabs.

16799 **(CONF-890304—26) Development of a remotely maintainable radio-frequency module for the Compact Ignition Tokamak.** Snider, J.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004913/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Compact Ignition Tokamak (CIT) will require reliable remote handling (RH) systems to overcome failures in diagnostic and operational equipment. Oak Ridge National laboratory (ORNL) is responsible for the ex-vessel remote maintenance systems for the CIT. Part of this effort is performing remote maintenance demonstrations on replicas of various CIT equipment. To ensure successful RH, the machine must be designed with proven remote maintenance features. In the demonstrations, critical remote maintenance features are tested before actual CIT equipment designs are finalized. Designs and procedures required to remotely remove and install a radio-frequency (rf) module from a modplane port on the tokamak were recently demonstrated at ORNL. This testing identified both successful design features for remote maintenance of the rf module and areas that require further development. 1 ref., 11 figs.

16800 **(CONF-890304—27) Maintenance concept development for the Compact Ignition Tokamak.** Macdonald, D. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004914/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The Compact Ignition Tokamak (CIT), located at the Princeton Plasma Physics Laboratory, will be the next major experimental machine in the US Fusion Program. Its use of deuterium-tritium (D-T) fuel requires the use of remote handling technology to carry out maintenance operations on the machine. These operations consist of removing and repairing such components as diagnostic equipment modules by using remotely operated maintenance equipment. The major equipment being developed for maintenance external to the vacuum vessel includes both bridge-mounted and floor-mounted manipulator systems. Additionally, decontamination (decon) equipment, hot cell repair facilities, and equipment for handling and packaging solid radioactive waste (rad-waste) are being developed. Recent design activities have focused on establishing maintenance system interfaces with the facility design, developing manipulator system requirements, and using mock-ups to support the tokamak configuration design. 3 refs., 8 figs.

16801 **(CONF-8802131—1) Remote maintenance concepts for the Compact Ignition Tokamak.** Davis, F.C.; Hager, E.R. (Oak Ridge National Lab., TN (USA); SEE CODE-9525697 General Atomics Co., San Diego, CA (USA)). 1988. Contract AC05-84OR21400;AC03-84ER53158. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005670/JAW.

From International meeting on robotics and remote maintenance concepts for fusion machines; Karlsruhe, F.R. Germany (22 Feb 1988).

Because deuterium-tritium fuel will be used in the Compact Ignition Tokamak (CIT), remote handling technology is needed to carry out some maintenance operations on the machine. In keeping with the compact, low-cost nature of CIT, remote maintenance is provided only for systems with the highest probability of failure. Remote operations include removing, repairing (if feasible), and replacing such components as thermal protection tiles on the first wall, radio-frequency (rf) heating modules, and diagnostic modules. For maintenance inside the vacuum vessel, major pieces of equip-

ment under development include an articulated boom manipulator with servomanipulators, an inspection manipulator, and special tooling. For maintenance outside the cryostat, remote equipment includes a bridge-mounted manipulator system, equipment for decontamination and hot cell activities, and for handling and packaging solid radioactive waste. The conceptual design phase of the CIT project is nearing completion; research and development activities in support of the project include demonstrations of remote maintenance operations on full-size partial mock-ups. 9 figs.

16802 **(ENEA-RT-FUS—88-6) Confinement and diffusion in tokamaks.** McWilliams, R. (California Univ., Irvine (USA). Dept. of Physics). (ENEA, Rome (Italy)). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705437/JAW.

The effect of electric field fluctuations on confinement and diffusion in tokamak is discussed. Based on the experimentally determined cross-field turbolent diffusion coefficient, D~3.7*cT/sub e//eB(δn/sub i//n/sub i/)/sub rms/ which is also derived by a simple theory, the cross-field diffusion time, tp=a/sup 2//D, is calculated and compared to experimental results from 51 tokamak for standard Ohmic operation. 19 refs.

16803 (INIS-SU—65, pp 74-77) **Device for simulation of the conditions of plasma interaction with TNR structural components.** Volkov, E.D.; Gribanov, Yu.A.; Opalev, O.A.; Rudakov, V.A.; Rybalko, V.F.; Ternopol, A.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780059/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(43).

In Physic of radiation damage and radiation material technology. Scientific-technical collection.

A plasma device permitting to simulate conditions arising in near-the-wall region and in the region of limiters in future thermonuclear reacors is described. Energy distribution of incident plasma ions, angular distribution, ion fluxes achieving the target-cathode, are measured. Conditions of hydrogen plasma interaction with the main elements of thermonuclear reactor design are shown to be well simulated in a reflective discharge. 4 refs.; 6 figs.

16804 **(KFKI—1988-40/A) Dynamics of the fusion reaction in the dtμ/sup -/ system.** Belyaev, V.B.; Revai, J.; Zubarev, A.L. (Joint Inst. for Nuclear Research, Dubna (USSR); Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Aug 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705570/JAW.

A dynamical scheme based on the (td,αn) two-channel model is derived for the description of the fusion reaction in the dtμ/sup -/ system. Special attention is paid to the correct specification of the final states. Several possibilities are pointed out for the systematic improvement of the sudden approximation for the sticking coefficient. It seems to be useful to outline a general formulation of these processes which would allow a clear comparison of existing approaches. The lack of satisfactory agreement between experimental and theoretical values of the sticking coefficient is a further argument in favour of the programme. (R.P.) 10 refs.

16805 **(LA-UR—88-4206) Development KrF lasers for inertial confinement fusion.** Figueira, J.F.; Rosocha, L.A.; Sorem, M.S.; Harris, D.B. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 8p. (CONF-890145—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE8900ↄ469/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

High peak power rare gas halide lasers for applications in Inertial Confinement Fusion are being developed at laboratories across the world. The United States Department of Energy sponsors a program conducted at the Los Alamos National Laboratory and the Naval Research Laboratory. The Los Alamos laser development program is composed of three major elements; the Aurora Laser Facility is a 1 terawatt KrF laser designed as an integrated performance demonstration of a target qualified excimer laser system; an advanced design effort evaluates concepts that offer the improved performance and lower cost that will be essential for the construction of future lasers in the 0.5 to 10 MJ class; and a laser technology program that addresses both performance and cost issues that will be important in advanced laser system designs. 4 figs.

16806 **(LA-UR—89-49) Modeling the energy deposition in the Aurora KrF laser amplifier chain.** Comly, J.C.; Czuchlewski, S.J.; Greene, D.P.; Hanson, D.E.; Krohn, B.J.; McCown, A.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-881002—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006545/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Monte Carlo calculations model the energy depositions by highly energetic electron beams into the cavities of the four KrF laser amplifiers in the Aurora chain. Deposited energy density distributions are presented and studied as functions of e-beam energy and gas pressure. Results are useful for analyzing small signal gain (SSG) measurements and optimizing deposition in future experiments. 7 refs., 7 figs., 1 tab.

16807 **(LBL—26323) Induction linac drivers: Prospects for the future.** Keefe, D. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 15p. (CONF-8806101—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006610/JAW.

From International symposium on heavy ion inertial fusion; Darmstadt, F.R. Germany (28 Jun 1988).

This review is intended to place in perspective our current view of the parameter ranges for induction linac drivers that lead to attractive scenarios for civilian electrical power plants; there is a surprising degree of choice (a factor of two or so in most parameters) before any significant impact on the cost of energy results. The progress and goals of the US Heavy Ion Accelerator Research (HIFAR) program are reviewed. The step between the realization of the HIFAR goals and a full-scale driver is seen to be very large indeed and will require one or more significant intermediate steps which can be justified only by a commitment to advance the HIF method towards a true fusion goal. Historical anomalies in the way that fusion programs for both military and civilian applications are administered will need to be resolved; the absence of any presently perceived energy crisis results in little current sense of urgency to develop vigorous long-term energy solutions. 12 refs., 3 figs., 1 tab.

16808 **(PPPL—2579) Computation of zero β three-dimensional equilibria with magnetic islands.** Reiman, A.H.; Greenside, H.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006881/JAW.

A Picard iteration scheme has been implemented for the computation of toroidal, fully three-dimensional, zero β equilibria with islands and stochastic regions. Representation of the variables in appropriate coordinate systems has been found to be a key to making the scheme work well. In particular, different coordinate systems are used for solving magnetic differential equations and Ampere's law. The current profile is adjusted when islands and stochastic regions appear. An underrelaxation of the current profile modifications is generally needed for stable iteration of the algorithm. Some examples of equilibrium calculations are presented. 16 refs., 6 figs., 1 tab.

16809 **(PPPL—2586) Polarization characteristics of wire mesh at 119 μm.** Hwang, Y.S.; Park, H.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1989. Contract AC02-76CH03073. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006874/JAW.

Polarization characteristics of the transmitted beam through the various sizes of metal wire grid meshes are examined experimentally at 118.8 μm. When these results are compared to Chen's

wave guide theory, we have obtained excellent agreement. In particular, when the incident beam polarization is neither parallel (TM) nor perpendicular (TE) to the wire grid axis, a linearly polarized incident beam can be made elliptic due to the phase difference between the TE and TM modes. 7 refs., 4 figs

16810 **(UCID—19604-Rev.1) Updated summary of measurements and calculations of neutron and gamma-ray emission spectra from spheres pusled with 14-MeV neutrons: Revision 1.** Hansen, L.F.; Goldberg, E.; Howerton, R.J.; Komoto, T.T.; Pohl, B.A. (Lawrence Livermore National Lab., CA (USA)). 19 Jan 1989. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006804/JAW.

New measurements of the neutron and gamma-ray emission spectra from materials of interest to thermonuclear reactors with a 14 MeV neutron source were done during 1986 and 1987. These measurements characterized by better resolution than those reported in the Summary published in 1982, were performed using the pulsed sphere and time-of-flight techniques. The detector used in these measurements was a NE-213 cylinder, 5.08 cm in diameter by 5.08 cm thick. The new measurements include the following materials: Be, C, N, H_2O, C_2F_4 (teflon), Al, Si, Ti, Fe, Cu, Ta, W, Au, Pb, ^{232}Th, and ^{238}U. For all these materials, both the neutron and gamma emission spectra were measured. A complete tabulation of all the measurements done under the Pulse Sphere Program is presented. 37 refs., 1 tab.

16811 **(UCID—21590) A point design for the ITER cryogenic system.** Slack, D.S. (Lawrence Livermore National Lab., CA (USA)). 27 Oct 1988. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006228/JAW.

Here we describe a cryogenic system suitable for ITER in it's present form. The purpose is to show that ITER requirements can be efficiently met by a relatively simple cryogenic system. 3 figs., 3 tabs.

16812 **(UCID—21623) Verification of shielding calculation on the DIII-D facility at La Jolla, California.** Plechaty, E.F. (Lawrence Livermore National Lab., CA (USA)). 30 Jan 1989. Contract W-7405-ENG-48. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007276/JAW.

Shielding calculations were performed for the DIII-D facility at La Jolla to independently assess the biological dose from radiation emitted during operation. These calculations for both the fully shielded and bare configurations are in essential agreement with those done by Gulf. In addition to the basic test problems run by Gulf, a bare configuration with additional air outside the facility area was calculated. The addition of air to the bare configuration caused the dose at 100 meters from the DIII-D center-line to increase by fifty five percent. The inclusion of the various elemental constituents in the soil composition may change the calculated dose, but will not change the shielding factor nor invalidate the overall conclusion of this report. The overall conclusion is that Gulf and LLNL results are in general agreement. 5 refs., 11 figs., 5 tabs.

16813 **(UCRL—21181) Analyses in support of the Laboratory Microfusion Facility and ICF commercial reactor designs.** Meier, W.R.; Monsler, M.J. (Schafer (W.J.) Associates, Inc., Albuquerque, NM (USA)). 28 Dec 1988. Contract W-7405-ENG-48. 167p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007026/JAW.

Our work on this contract was divided into two major categories; two thirds of the total effort was in support of the Laboratory Microfusion Facility (LMF), and one third of the effort was in support of Inertial Confinement Fusion (ICF) commercial reactors. This final report includes copies of the formal reports, memoranda, and viewgraph presentations that were completed under this contract.

16814 **(UCRL—94975-Rev.1) Lawrence Livermore National Laboratory x-ray laser research: Recent results.** MacGowan, B.J.; Brown, S.; Campbell, E.M.; Eckart, M.; Hagelstein, P.; Keane, C.; London, R.; Matthews, D.; Nilson, D.; Phillips, T. (Lawrence Livermore National Lab., CA (USA)). Aug 1986. Contract W-7405-ENG-48. 24p. (CONF-8608238—1-Rev.1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003898/JAW.

From Multilayer structures and laboratory X-ray laser research; San Diego, CA, USA (19 Aug 1986).

Since the successful demonstration of gain in neon-like selenium using an exploding foil amplifier, the x-ray laser group at Lawrence Livermore National Laboratory has investigated further the exploding foil amplifier concept for use in XUV lasers. Results are reported of the characteristics of selenium amplifiers up to 50 mm in length. Observation of at least 16 gain lengths for the 206 {angstrom} line of selenium is reported. Output powers in excess of 1 MW have been measured in pulses of approximately 200 psec. The effects of refraction on the performance of long amplifiers have been studied. The occurrence time of the x-ray laser output relative to the input heating pulse has been measured and found to be in disagreement with a recent model that suggests three-body recombination driven by rapid radiative cooling as the inversion process in the selenium plasma. An exploding foil amplifier has been used to demonstrate gain in an analogous scheme in neon-like molybdenum. The (2p/sub 3/2/ 3s)/sub J=1/ {minus} (2p/sub 3/2/ 3p/sub 3/2/)/sub J=0/ transition at 106.4 {angstrom} has been observed to have a gain of order 2 cm/sup {minus}1/. The (2p/sub 1/2/ 3s)/sub J=1/ {minus} (2p/sub 1/2/ 3p/sub 1/2/)/sub J=0/ line (analogous to the 182 {angstrom} line in selenium), has been identified at 141.6 {angstrom}, but displays negligible gain. 11 refs., 11 figs., 1 tab.

16815 **(UCRL—97490) The application of statistical experimental design to the development of low-density polymer foams.** Haendler, B.L.; Hair, L.M.; Kong, Fung-Ming. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 14p. (CONF-8806139—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006774/JAW.

From Symposium on computer applications in applied polymer science; Toronto, Canada (5 Jun 1988).

Statistical experimental designs have been used to improve the development of low-density polymer foams for use as direct-drive targets for Laser Inertial Confinement Fusion (ICF). For polystyrene foams, which are made by polymerization of a high-internal-phase emulsion, a three-variable Box-Behnken response surface methodology experiment led to quick identification of a reproducibility problem, which was resolved by moving to a different density regime. This experiment also confirmed the crucial role the surfactant (Span 80) plays in this system. For resorcinol-formaldehyde foams, which are made by a condensation polymerization in dilute solution, a fractional-factorial screening study identified key variables which were then investigated further. The striking result here was that testing ranges of variables outside what had previously been considered led to better quality samples with much lower densities. 12 refs., 5 figs., 3 tabs.

16816 **(UCRL—98669) Progress on achieving the ICF conditions needed for high gain.** Lindl, J.D. (Lawrence Livermore National Lab., CA (USA)). 23 Dec 1988. Contract W-7405-ENG-48. 9p. (CONF-881031—60). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006152/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

Progress during the past two years has moved us much closer to demonstrating the scientific and technological requirements for high gain ICF in the laboratory. This progress has been made possible by operating at the third harmonic of 1μm light which dramatically reduces concern about hot electrons and by advances in diagnostics such as 100 ps x-ray framing cameras which greatly increase the data available from each experiment. Making use of many of these new capabilities, major improvements in confinement conditions have been achieved for ICF implosions. In particular, in an optimized hohlraum on Nova, radiation driven implo-

sions with convergence ratio in excess of 30 (volume compression {approximately}3 {times} 10^4) have performed essentially as predicted by spherical implosion calculations. This paper presents these results as well as examples of advances in several other areas and discusses the implications for the future of ICF with lasers and heavy ion beam drivers. 8 refs., 10 figs.

16817 **(UCRL—99295) Structural damage and analysis of the Nova final focusing lenses.** Pitts, J.H. (Lawrence Livermore National Lab., CA (USA)). 9 Jan 1989. Contract W-7405-ENG-48. 5p. (CONF-8810246—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006157/JAW.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (26 Oct 1988).

Two types of damage (cracking and pitting) have been observed on the Nova fused-silica-glass final focusing lenses. Cracking occurred in the center of the vacuum (tension) face of one lens. We believe the cracking was a result of acoustic waves focusing radially on the axis of the lens, producing tensile stresses that exceeded the strength of the glass. This type of damage can result in catastrophic failure and in extensive damage to expensive equipment. This lens was removed immediately and pressure tested to failure. Failure occurred when a pressure difference of 150 kPa was placed across the lens---which is only 50% higher than the pressure difference at normal operating conditions. Pitting occurs because laser light is diffracted and scattered around an apodized groove, concentrating in a annular region on the vacuum face. It also occurs at random locations when contaminants, adhering to the lens vacuum face, absorb laser light. In both cases, thermal stresses produce pitting; however, this pitting is not of structural concern because any flaws exceeding the fracture toughness of the glass propagate toward the vacuum face where the highest tensile stresses in the lenses exist. 10 refs., 2 figs.

16818 **(UCRL—99821) Saturation and damping of stimulated Raman scattering (SRS).** Drake, R.P.; Young, P.E.; Williams, E.A.; Darrow, C.B.; Estabrook, K.; Montgomery, D.S.; Kruer, W.L.; Baldis, H.A.; Johnston, T.W. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 5p. (CONF-881056—10). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006235/JAW.

From 19. European conference on laser interaction with matter (ECLIM); Madrid, Spain (3 Oct 1988).

Three experiments are discussed that investigated the saturation and damping of the SRS instability. First, 3 μm thick CH targets were exploded by up to 2 kJ of 0.35 μm laser light in pulses of 1 to 4.4 ns at 10^{13} to 4 x 10^{15} W/cm^2. The laser intensity, pulse length, and spot size were systematically varied to study, in planar plasmas, the dependence of SRS on either laser intensity or density-gradient sale length. This produced evidence that SRS was as absolute instability under the conditions of these experiments. Second, 15 μm thick CH targets were exploded by about 18 kJ or 0.35 μm light to produce a reactor-scale, underdense plasma. This plasma was irradiated by an intense (10^{15} W/cm^2), 0.35 μm laser beam and was measured to produce an SRS reflectivity of 15%. Third, thin Au targets were irradiated at intensities of 10^{14} to 4 x 10^{15} W/cm^2 with up to 2 kJ of 0.35 μm light. When the ratio of electron-ion collision rate to SRS growth rate reached unity, the emissions in the SRS frequency band abruptly dropped to thermal levels. 11 refs., 3 figs.

16819 **Measurements of temporal and spatial characteristics of electrohydrodynamic instabilities.** Pregenzer, A.L.; Woodworth, J.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **65**: No. 5, 1823-1828(1 Mar 1989).

Since an electrohydrodynamically (EHD) driven liquid-lithium ion source is being developed for experiments on the Particle Beam Fusion Accelerator II at Sandia National Laboratories, EHD experiments have been started with several liquids. In this paper, we present results of experimental studies of the behavior of the surface of water and ethanol in the presence of 15—40-kV/cm dc electric fields. Fields of this magnitude can produce unstable growth of surface perturbations with wavelengths in the 0.1—1.0 cm range. There is excellent agreement between theory and experiment for values of the wavelength of the dominant mode as a function of the applied electric field E_0. Theoretical predictions about the temporal behavior of cusp formation are consistent with experiment. The experimental results are applicable, via scaling laws, to liquids in the presence of electric fields in the 1—50 MV/cm range, where unstable surface perturbations may produce field enhancements sufficient to field evaporate ions from the liquid surface.

16820 **Measurements of lateral thermal smoothing of 0.53-μm laser intensity nonuniformities via shock-wave analysis.** Shepard, C.L.; Campbell, P.M. (Battelle Northwest, P.O. Box 999, Richland, Washington 99352). *Physical Review [Section] A: General Physics;* **39**: No. 3, 1344-1350(1 Feb 1989).

Studies of the effects of laser intensity nonuniformities on the ablation pressure profile of irradiated Si disk targets were made by measurement of the velocity profile of the shock wave launched into the target. The results show significant lateral smoothing of laser nonuniformities which increases with intensity. Experimental data are matched in two-dimensional hydrocode calculations with classical lateral heat flux.

16821 **New concept for muon catalyzed fusion reactor.** Tajima, T.; Eliezer, S.; Kulsrud, R.M. (Institute for Fusion Studies and Department of Physics, The University of Texas at Austin, Austin, Texas 78712). *AIP (American Institute of Physics) Conference Proceedings;* **181**: No. 1, 423-434(27 Dec 1988). (CONF-8805170—).

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

A new concept for a muon catalyzed pure fusion reactor is considered. To our best knowledge this constitutes a first plausible configuration to make energy gain without resorting to fissile matter breeding by fusion neutrons, although a number of crucial physical and engineering questions as well as details have yet to be resolved. A bundle of DT ice ribbons (with a filling factor f) is immersed in the magnetic field. The overall magnetic field in the mirror configuration confines pions created by the injected high energy deuterium (or tritium) beam. The DT materials is long enough to be inertially confined along the axis of mirror. The muon catalyzed mesomolecule formation and nuclear fusion take place in the DT target, leaving α^{++} and occasionally $(\alpha\mu)^+$ (muon sticking). The stuck muons are stripped fast enough in the target, while they are accelerated by ion cyclotron resonance heating when they circulate in the vaccum (or dilute plasma). The ribbon is (eventually) surrounded and pressure-confined by this coronal plasma, whereas the corona is magnetically confined. The overall bundle of ribbons (a pellet) is inertially confined. This configuration may also be of use for stripping stuck muons via the plasma mechanism of Menshikov and Ponomarev.

16822 **Design of the reversatron II RFP.** Greene, P. (Univ. of Colorado, Boulder, CO (US)); Robertson, S.H. (Univ. of Colorado, Boulder, CO (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 6, 667-672(Dec 1988).

The design and initial operation of a small (R/a = 50 cm/8cm) reversed field pinch, the Reversatron II, are described. The device has an air core, a thin removeable shell, and relatively low field errors. Equilibrium is maintained by a preprogrammed vertical field which has a variable index and is inductively decoupled from other circuits. Discharges having a 22 kA plasma current and duration of 500 μsec are obtained.

16823 **Corresponding aspects of strong-field multiquantum processes and ion-atom collisions.** Boyer, K.; Gibson, G.; Jara, H.; Luk, T.S.; McIntyre, I.A.; McPherson, A.; Rosman, R.; Solem, J.C.; Rhodes, C.K. (Lab. for Atomic, Molecular, and Radiation Physics, Dept. of Physics, Univ. of Illinois at Chicago, P.O. Box 4348, Chicago, IL (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 541-547(Oct 1988).

Corresponding aspects of multiphoton processes and ion-atom collisions are explored. With a simple model, a set of relation-

ships is derived which relate the radiative power, frequency, and pulse width governing multiphoton coupling to the corresponding variables of ion charge, collisional velocity, and impact parameter involved in collisional reactions. Comparisons of spectral data in the extreme ultraviolet region for Ne, Ar, Kr, and Xe produced by collisional excitation and subpicosecond ultraviolet laser irradiation indicate approximate conformance with the expectations stemming from this analysis. These results suggest that, for ultraviolet radiation, this approach may be useful in understanding the gross features of the strong-field multiquantum interaction over the range of intensity spanning from —10/sup 16/ W/cm/sup 2/ to —10/sup 21/ W/cm/sup 2/. Collisional data on transfer ionization occurring in ion-atom collisions are also used to estimate the conditions under which multiphoton processes should be appreciably influenced by multielectron motions.

16824 **Ion-beam focusing in a double-plasma device.** Johnson, J.C.; D'Angelo, N.; Merlino, R.L. (Dept. of Physics and Astronomy, Univ. of Iowa, Iowa City, IA (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 590-596(Oct 1988).

The authors have studied the propagation of a low-energy, charge-neutralized ion beam which is injected into the target region of a long double-plasma (DP) device. A magnetic field of up to —180G may be applied along the axis of the device. As a result of charge exchange collisions, the ion beam is attenuated as it propagates into the target region. However, under certain conditions of magnetic field strength and neutral gas pressure, they have observed a "reemergence" of the beam on axis far downstream in the target. This reemergence of the ion beam is attributed to a focusing of the ions by a self-consistently produced radial ambipolar electric field. The effect may be expected to occur in other types of plasma devices as well, whenever a sufficiently large radially inward electric field is present.

16825 **A reflex electron beam discharge as a plasma source for electron beam generation.** Murray, C.S.; Rocca, J.J.; Szapiro, B. (Dept. of Electrical Engineering, Colorado State Univ., Fort Collins, CO (US));. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 5, 570-573(Oct 1988).

A reflex electron beam glow discharge has been used as a plasma source for the generation of broad-area electron beams. An electron current of 120 A (12 A/cm/sup 2/) was extracted from the plasma in 10 μs pulses and accelerated to energies greater than 1 keV in the gap between two grids. The scaling of the scheme for the generation of multikiloamp high-energy beams is discussed.

16826 **Palladium-coated zirconium membranes for oxidative extraction of hydrogen.** Hsu, C.; Buxbaum, R.E. New York, NY; American Institute of Chemical Engineers (1987). 22p. (CONF-871113—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

Technical Paper 33G.

Palladium-coated metal membranes are attractive choices for low pressure, high temperature hydrogen and hydrogen isotope extractions, e.g. from fusion blanket fluids. The authors present experimental data on hydrogen transport through palladium-coated zirconium membranes at 600 - 700°K. The upstream hydrogen pressure range is 10/sup -4/ to 10/sup -6/ torr and an oxygen-containing gas flows over the downstream side of the membrane. Thus, the irreversible oxidation reaction drives the flux. Deuterium permeabilities in zirconium are 2.00x10/sup -6/exp(59/T)+-20% g-mol/m.s.Pa/sup 1/2/, similar to the values obtained from diffusivity and solubility measurements. Extrapolated deuterium absorptive sticking coefficients on palladium are about .05.

16827 **Neutron streaming analysis of an aqueous self-cooled blanket applied to MARS.** Varsamis, G.L.; Embrechts, M.J.; Steiner, D. (Dept. of Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, NY (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A novel fusion reactor blanket concept, the Aqueous Self Cooled Blanket concept (ASCB), has recently been proposed. One of the first applications of this concept was to a MARS-like tandem mirror reactor. The design employs spiraling tubes of zircaloy-4 housed in a structural casing made of a vanadium alloy (V-15Cr-5Ti). One potential problem area for this design is the possibility for neutron streaming between the zircaloy tubes. This work examines this potential streaming path using the MCNP Monte Carlo code. The results of the total and the uncollided flux indicate a noticeable streaming effect on the uncollided flux only. An analysis of the energy deposition behind the blanket indicates that this effect is small, and therefore design modifications due to this streaming effect are not anticipated.

16828 **An aqueous self-cooled shielding blanket for NET.** Embrechts, M.J.; Bogaerts, W.; Chazalon, M.; Daenner, W.; Steiner, D.; Varsamis, G. (Dept. of Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, NY (US));. pp v of Proceedings of the topical conference on theory and practices in radiation protection and shielding. Volumes 1-2. La Grange Park, IL; American Nuclear Society (1987). (CONF-870405—).

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

A low-technology Aqueous Self-Cooled Blanket (ASCB) concept has been proposed for a shielding/driver blanket for the Next European Torus (NET). NET will operate with a low temperature minimal shielding-thickness blanket in the first operation stage to provide room for a larger plasma chamber, thereby relaxing some of the plasma physics constraints. An ASCB blanket utilizes small amounts of lithium compound dissolved in the water to breed tritium, and is especially applicable to gain tritium breeding experience based on available technology. Such a shielding blanket could provide a significant part of the tritium needs for NET, even with the minimal shielding blanket dimensions.

16829 **Induction LINACS and free electron laser amplifiers.** Briggs, R.J. (Univ. of Rochester, Rochester, NY (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

The purpose of this conference, as the author understands it, is to bring together the communities involved in fusion research with those involved in directed energy weapons research. Others have pointed out that there have actually been many connections in the past between activities in fusion research and directed energy weapons. In fact, the activity that he has been involved with at Livermore is probably one of the prime examples of this. The author gives some perspectives on how these activities interacted over the years. With the formation of the Strategic Defense Initiative (SDI), which is a rather significant new national endeavor, a sense of history is often important. A major component of the controlled fusion program at Livermore back in the early 1970's was a machine called Astron. The purpose of the Astron experiment was to generate plasma confinement through magnetic field reversal from a circulating electron ring. Next to the Astron fusion experiment was a buncher ring in which the electron beam from the Astron accelerator went around in a circle and over into a 60-foot propagation tank next door.

16830 **Pulsed power, ICF, and SDI.** Van Devender, J.P. (Pulsed Power Sciences, Sandia National Labs., Albuquerque, NM (US));. pp v of Proceedings of a symposium on lasers and particle beams for fusion and strategic defense. Gaithersburg, MD; Fusion Power Associates (1985). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

Pulsed power technology has been developed over many years for nuclear weapon effects simulation, inertial fusion, and directed energy. Every four years there is a factor of ten increase in power available, and the authors are now near the 100 TW couple of million joule mark. A million joules (MJ) is about what you need to kill a booster and 100 TW is sufficient for studying physics relevant to Inertial Confinement Fusion (ICF) or the Strategic Defense Initiative (SDI). The applications of this technology are many. Pulsed power should be viewed as a basic technology for making electron beams, x-rays, and ion beams. Applications include ICF, plasmoid directed energy weapons, x-ray lasers, electron beams as directed energy weapons, and microwave weapons. The diversity of pulsed power is also one of its drawbacks. The authors have to develop criteria to decide what not to work on.

16831 **Proceedings of a symposium on lasers and particle beams for fusion and strategic defense.** Gaithersburg, MD; Fusion Power Associates (1985). 150p. (CONF-850476—). Fusion Power Associates, 2 Professional Dr., Suite 248, Gaithersburg, MD 20879.

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

This book compiles the papers presented at the conference on the subject of "Lasers and Particle beams for Fusion and Strategic defense". The conference was held at the University of Rochester. The topics of discussions were: Issues faced by strategic defense initiative; accelerators for heavy ion fusion; RF accelerators; pulsed power, ICF and SDI; Induction LINACS and lasers for fusion research.

99 GENERAL AND MISCELLANEOUS

16832 **(DOE/S—0010(87)) Annual report to Congress.** (USDOE, Washington, DC). 1987. 404p. NTIS, PC A18/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006313/JAW.

This is the ninth Annual Report to Congress of the United States Department of Energy. It covers the activities of all elements of the Department except the independent Federal Regulatory Commission, which issues its own annual report. 88 refs., 43 tabs.

16833 **(DOE/SR/15199—1) Savannah River Archaeological Research Program: Annual report, FY 1988.** Hanson, G.T. (South Carolina Univ., Columbia (USA). Inst. of Archaeology and Anthropology). 30 Aug 1988. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006285/JAW.

The past year has witnessed the continuation of the SRARP tradition of scholarly research through contract, grant and volunteer support. Archaeological opportunities have been provided to the professional, student and avocational communities through a range of projects and programs. With the implementation of a new cooperative grant, the scope of SRARP research and public service activities will continue to examine the prehistoric and historic archaeological records of the region and to present objectively these results to professional and avocational audiences. During the forthcoming year (FY 1989) the SRARP will continue to conduct and facilitate archaeological research within the Savannah River valley for the purpose of better understanding the early history and prehistory of the region.

16834 **(LA—11395-MS) Survivability of space assets in the long term.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 95p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006563/JAW.

This report discusses the threats to strategic defense satellites over the next 20-30 years. It describes the purposes and sizes of the satellites, the types of attacks on them, the counters to those attacks, and the likely outcomes of the encounters. It concludes that their survivability and contribution to stability should increase over then next 20-30 years because of the advanced technologies that should become available then. 47 refs., 14 figs.

16835 **(N—89-11760) Technology for future NASA missions: civil space technology initiative (CSTI) and pathfinder.** (National Aeronautics and Space Administration, Washington, DC (USA)). Sep 1988. 550p. (NASA-CP—3016; NAS—1.55:3016; CONF-8809277—). NTIS, PC A23/MF A01.

From Technology for future NASA missions: Civil space Technology Initiative (CSTI) and pathfinder; Washington, DC, USA (12 Sep 1988).

Information is presented in viewgraph form on a number of related topics. Information is given on orbit transfer vehicles, spacecraft instruments, spaceborne experiments, university/industry programs, spacecraft propulsion, life support systems, cryogenics, spacecraft power supplies, human factors engineering, spacecraft construction materials, aeroassist, aerobraking and aerothermodynamics.

16836 **(N—89-12582) Fifteenth space simulation conference: support the highway to space through testing.** Stecher, J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). 1988. 492p. (NASA-CP—3015; REPT—88B0253; NAS—1.55:3015; CONF-8810291—). NTIS, PC A21/MF A01.

From 15. space simulation conference: support the highway to space through testing; Williamsburg, VA, USA (31 Oct 1988).

The Institute of Environmental Sciences Fifteenth space simulation conference, Support the Highway to Space Through Testing, provided participants a forum to acquire and exchange information on the state-of-the-art in space simulation, test technology, thermal simulation and protection, contamination, and techniques of test measurements.

16837 **(N—89-12626) Advanced Earth-to-orbit propulsion technology 1986, volume 2.** Richmond, R.J.; Wu, S.T. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Oct 1986. vp. (NASA-CP—2437-VOL-2; M—541-VOL-2; NAS—1.55:2437-VOL-2; CONF-8605142—). NTIS, PC A99/MF E03.

From Conference on advanced earth-to-orbit: propulsion technology; Huntsville, AL, USA (13 May 1986).

Technology issues related to oxygen/hydrogen and oxygen/hydrocarbon propulsion are addressed. Specific topics addressed include: rotor dynamics; fatigue/fracture and life; bearings; combustion and cooling processes; and hydrogen environment embrittlement in advanced propulsion systems.

16838 **(UCID—21558) Review and analysis of the literature in the area of human performance modeling.** Burton, H.D.; Butler, J.; Banks, W.W.; Berghage, T.E. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 141p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006800/JAW.

The following review of the literature in the area of human performance modeling was compiled in conjunction with work sponsored by the US Naval Health Research Center, San Diego, California, on the application of human performance data in wargaming models and simulation. The results were obtained by searching a number of on-line retrieval systems, downloading the data, and processing it using software developed by the Technology Information Systems Program. Databases which were searched included PsycINFO (American Psychological Association), Compendex (Engineering Index), Inspec (Institute of Electrical Engineers), NTIS (National Technical Information Service), DROLS (Department of Defense), NASA-Recon (National Aeronautics and Space Administration), Science Citation Index (Institute for Scientific Information), Conference Papers Index (Cambridge Scientific Abstracts), and a number of other databases which produced no re-

trieval results. Those citations identified as part of the PsycINFO databases are reprinted with permission of the American Psychological Association, publisher of Psychological abstracts and the PsycINFO database (Copyright c 1967--1988 by the American Psychological Association), and may not be reproduced without its prior permission. The retrieval citations were then converted to a common format, duplicates were eliminated, and the resulting master set was sorted and formatted for printing. Indexes and various analyses were produced as the final step in creating this publication. The major listing is alphabetical by author and includes abstracts where they were available. An index to authors follows as well as several frequency lists to provide an overview of the coverage. Additional information concerning either the bibliography or the software used to create it may be obtained form Hilary Burton, TIS Program, Lawrence Livermore National Laboratory.

9901 Management

REFER ALSO TO CITATION(S) 14718, 16904

16839 (IA—1440, pp 270-271) **Training of radiation workers in Israel in 1987.** Schlesinger, T.; Surkes, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1988. NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705322/JAW.

In Research laboratories annual report 1987.

16840 (INIS-GB—172) **Daresbury 1987/8.** (Daresbury Lab. (UK)). 1988. 56p. NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705523/JAW.

1987 was the twenty fifth anniversary of the Daresbury Laboratory and special events were held to celebrate this. Over the twenty five years the projects have changed but the role of the laboratory, which is to provide and operate facilities too large for a single University to operate on its own and to collaborate with the Universities using them, has not changed. The report covers the main facilities at Daresbury. The main events and progress throughout the year are highlighted. For the Nuclear Structure facility highlights included collaboration on the largest array of high resolution germanium gamma-ray detectors ever assembled, work on super deformed nuclei at high angular momentum and the use of the polarised heavy ion source. At the Synchrotron Radiation Source a High Brightness Lattice has been installed and this has resulted in improved imaging and diffraction. Protein molecules, semiconductor materials, very small crystals and muscle structure have been studied using the high brightness lattice facility. A review of the computational science support for projects is included. Facts and figures about Daresbury are presented and a list of publications resulting from work done at the Laboratory during the year is given. (U.K.).

16841 (IT—1986, pp 11) **Can systems be made to pay.** Gentry, M.J. (Diamond Shamrock Exploration Co.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

A discussion is presented on the advantages of oil and gas companies investing in the development of integrated software systems. The experience of a medium-sized exploration company in developing an integrated capital and operations reporting system is reported. Improvements in software availability since that time have occurred, meaning that the total software solution is one of the most cost-effective ways of delivering a new integrated system, although at the cost of having to change company procedures to correspond with those of the software. An alternative approach suggested in this paper is the use of prototyping, which refers to applications designed under a common technical architecture that are used as models and customized to fit a particular company's needs. Prototyping provides access to the collective experiences of other oil and gas companies, and reduces the cost and risk of developing integrated systems while still allowing delivery of customized applications. 2 figs.

16842 (WHC-SA—0377) **Measuring performance of custodial and transportation service crews.** Nordby, C.B. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1988. Contract AC06-87RL10930. 11p. (CONF-8810281—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004906/JAW.

From 4. Westinghouse statistic symposium; Pittsburgh, PA, USA (12 Oct 1988).

One definition of "statistics" is that it is a collection of numerical data. That may be an over-simplification, but statistics do not have to be complex to be a valuable tool for measuring performance–at any level in the organization. I would like to share with you today a success story from Westinghouse Hanford Company where we did use simple statistics and were able to make significant improvements in quality and productivity. As a maintenance supervisor, I had both teamsters and custodial staff reporting to me. Since we were a service group, many people may assume that it would be difficult to measure our performance. To some extent, that is true because management control systems tend to be less well developed for service groups than those in scientific or manufacturing organizations, where the quality and quantity of tangible goods can be readily measured.

16843 (X-EP-CREA-RA—1985) **Annual report of the Epistemology and Autonomy research center, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 23p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756699/JAW.

Research on the genealogy of the concept of self organization; the foundations of the cognitivist paradigm; inductive inference and knowledge; analysis of anticipation; the role of conventions; social communication; anthropology; political philosophy; literature theory; and the theory of culture is presented.

16844 (X-EP-CREA-RA—1986) **Annual report of the Epistemology and Autonomy research center, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 24p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756700/JAW.

Research on the genealogy of the concept of self organization; the foundations of the cognitivist paradigm; inductive inference and knowledge; analysis of anticipation; the role of conventions; social communication; anthropology; political philosophy; literature theory; and the theory of culture is presented.

16845 (X-EP-CRG-RA—1985) **Annual report of the Management Research Center, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 801p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756701/JAW.

Research on the management of new forms of automation; industrial management; the definition of a new product range; economic management; personnel management; and management of cultural enterprises is presented.

16846 (X-EP-CRG-RA—1986) **Annual report of the Management Research Center.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 38p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756702/JAW.

Research on the management of new forms of automation; industrial management; the definition of a new product range; economic management; personnel management; and management of cultural enterprises is presented.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 15477

16847 (ANL—87-26-Vol.2) Proceedings of the focused research program on spectral theory and boundary value problems: Volume 2: Singular differential equations. Kaper, H.G.; Kwong, Man Kam; Zettl, A. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 194p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006399/JAW.

This is the second volume of a series of reports containing the proceedings of the Focused Research Program on "Spectral Theory and Boundary Value Problems," which was held at Argonne National Laboratory during the period 1986-1987. The program was organized by the Mathematics and Computer Science (MCS) Division as part of its activities in applied analysis. The objective of the program was to provide an opportunity for research and exchange of views, problems, and ideas in three main areas of investigation: the theory of singular Sturm-Liouville equations, the asymptotic analysis of the Titchmarsh-Weyl m(λ)-coefficient, and the qualitative theory of nonlinear differential equations. The program had five full-time participants, who were joined by five more participants for periods of several months. Twenty-four mathematicians from the United States, Canada, and Europe visited for shorter periods for seminars and technical discussions. These proceedings are the permanent record of the research stimulated by the year-long program.

16848 (ANL/MCS-TM—126) Computing accurate eigensystems of scaled diagonally dominant matrices: LAPACK working note No. 7. Barlow, J.; Demmel, J. (Argonne National Lab., IL (USA)). Dec 1988. Contract W-31109-ENG-38. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006470/JAW.

When computing eigenvalues of symmetric matrices and singular values of general matrices in finite precision arithmetic we in general only expect to compute them with an error bound proportional to the product of machine precision and the norm of the matrix. In particular, we do not expect to compute tiny eigenvalues and singular values to high relative accuracy. There are some important classes of matrices where we can do much better, including bidiagonal matrices, scaled diagonally dominant matrices, and scaled diagonally dominant definite pencils. These classes include many graded matrices, and all symmetric positive definite matrices which can be consistently ordered (and thus all symmetric positive definite tridiagonal matrices). In particular, the singular values and eigenvalues are determined to high relative precision independent of their magnitudes, and there are algorithms to compute them this accurately. The eigenvectors are also determined more accurately than for general matrices, and may be computed more accurately as well. This work extends results of Kahan and Demmel for bidiagnoal and tridiagonal matrices. 17 refs.

16849 (ANL/MCS-TM—127) On a block implementation of Hessenberg multishift QR iteration: LAPACK working note No. 8. Bai, Z.; Demmel, J. (Argonne National Lab., IL (USA)). Jan 1989. Contract W-31109-ENG-38. 19p. NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number TI89006471/JAW.

The usual QR algorithm for finding the eigenvalues of a Hessenberg matrix H is based on vector-vector operations, e.g., adding a multiple of one row to another. The opportunities for parallelism in such an algorithm are limited. In this report, we describe a reorganization of the QR algorithm to permit either matrix-vector or matrix-matrix operations to be performed, both of which yield more efficient implementations on vector and parallel machines. The ideal is to chase a k by k bulge rather than a 1 by 1 or 2 by 2 bulge as in the standard QR algorithm. We report our preliminary numerical experiments on the CONVEX C-1 and CYBER 205 vector machines. 15 refs., 2 figs., 5 tabs.

16850 (ANL/TM—458-Rev.1) ANL statement of site strategy for computing workstations. Boxberger, L.M.; Izzo, R.; Saunders, D.J. (ed.). (Argonne National Lab., IL (USA)). Dec 1988. Contract W-31109-ENG-38. 38p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007050/JAW.

This Statement of Site Strategy describes the procedure at Argonne National Laboratory for defining, acquiring, using, and evaluating microcomputer and word processing equipment and software in accord with DOE Order 1360.1A (5-30-86), and Laboratory policy. It is Laboratory policy to actively promote the installation and use of computing workstations to improve productivity and communications for both programmatic and support personnel, to ensure that computing workstation acquisitions meet the expressed need in a cost-effective manner, and to ensure that acquisitions of computing workstations are in accord with Laboratory and DOE policies. The overall computing site strategy at ANL is to develop a hierarchy of integrated computing system resources to address the current and future computing needs of the Laboratory. The major system components of this hierarchical strategy are: supercomputers; centralized general purpose computers; distributed multipurpose minicomputers; and computing workstations and office automation support systems. 7 refs., 3 figs.

16851 (CEA-N—2583) ETA machines E and P models performance on the CEA benchmark. Patron, M. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Sep 1988. 13p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756634/JAW.

In this note, we present results for the CEA benchmark on the ETA 10-P and E supercomputers. To give an idea of the relative level of performances reached, we also give results for the Centre d'Etudes de Limeil-Valenton CRAY x-MP/416.

16852 (CMRC—82/55-BG) Computer system selection. Thornton, S.E. (Coal Mining Research Centre, Edmonton, Alberta (Canada)). 1982. 57p. (CE—02222). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document outlines the criteria being used for selecting a computer system to be used at the Coal Mining Research Centre in Devon, Alberta. The system will have to be able to run programs in Fortran 66 and will need a total memory size sufficient for complex simulation or comparison programs. Other selection criteria include compatibility with other systems, ability to upgrade the system as new hardware and software become available, reliability, and graphics capability. The document also includes reproductions of manufacturer's specifications and a listing for a pillar failure program.

16853 (CONF-881249—3) Increasing user-friendliness in AI systems. Agarwal, A.; Emrich, M.L. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005093/JAW.

From National Governor's Association meeting: finding the future conference; Washington, DC, USA (12 Dec 1988).

Recent trends have shown a rise in the number of non-technical computer users. This has resulted in increased emphasis on User Systems Interfaces (USI). New technology which has been developed includes: laser/optical mice, touch screens, voice synthesizers, and voice analyzers. This paper details hardware and software that have been the focus of recent research. The implementation of SOFTMAN, a software manager aid is also discussed. As part of its USI, SOFTMAN has each of the above interfaces. Future technologies and research paths will also be discussed. 25 refs., 4 figs.

16854 **(CONF-890304—10) Automatic learning by an autonomous mobile robot.** de Saussure, G.; Spelt, P.F.; Killough, S.M.; Pin, F.G.; Weisbin, C.R. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 6p. (CESAR—88/62). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003120/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

This paper describes recent research in automatic learning by the autonomous mobile robot HERMIES-IIB at the Center for Engineering Systems Advanced Research (CESAR). By acting on the environment and observing the consequences during a set of training examples, the robot learns a sequence of successful manipulations on a simulated control panel. The robot learns to classify panel configurations in order to deal with new configurations that are not part of the original training set. 5 refs., 2 figs.

16855 **(CONF-890304—22) Development of the HERMIES III mobile robot research testbed at Oak Ridge National Laboratory.** Manges, W.W.; Hamel, W.R.; Weisbin, C.R.; Einstein, R.; Burks, B.L.; Thompson, D.H.; Feezell, R.R.; Killough, S.M. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004797/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

The latest robot in the Hostile Environment Robotic Machine Intelligence Experiment Series (HERMIES) is now under development at the Center for Engineering Systems Advanced Research (CESAR) in the Oak Ridge National Laboratory. The HERMIES III robot incorporates a larger than human size 7-degree-of-freedom manipulator mounted on a 2-degree-of-freedom mobile platform including a variety of sensors and computers. The deployment of this robot represents a significant increase in research capabilities for the CESAR laboratory. The initial on-board computer capacity of the robot exceeds that of 20 Vax 11/780s. The navigation and vision algorithms under development make extensive use of the on-board NCUBE hypercube computer while the sensors are interfaced through five VME computers running the OS-9 real-time, multitasking operating system. This paper describes the motivation, key issues, and detailed design trade-offs of implementing the first phase (basic functionality) of the HERMIES III robot. 10 refs., 7 figs.

16856 **(CONF-8807146—1) A fast algorithm for linear complex Chebyshev approximation.** Tang, P.T.P. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005780/JAW.

From Conference on algorithms for approximation; Swindon, UK (12 Jul 1988).

A natural generalization of the Remez algorithm from real approximation to complex is presented. The algorithm is the first quadratically convergent of its kind. 13 refs.

16857 **(CONF-8808183—1) Parallel computation for stochastic dynamic programming: Row versus column code orientation.** Hanson, F.B. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 3p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003959/JAW.

From Institute of Electronic and Electrical Engineers meeting; St. Charles, IL, USA (15 Aug 1988).

Parallel computations are presented for stochastic dynamic programming problems arising from the optimal control of nonlinear, continuous time dynamical systems, perturbed by Poisson as well as Gaussian random white noise. The numerical formulation is highly suitable for a vector multiprocessor. Column-oriented code can run more than twice as fast as row-oriented code for highly refined meshes, but row-oriented code is more efficient and practical for coarser meshes. Advanced computing techniques and hardware help alleviate Bellman's curse of dimensionality in dynamic programming computations. 10 refs., 3 figs.

16858 **(CONF-8810297—1) Parallel direct solution of sparse linear systems.** Ng, E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006030/JAW.

From Workshop on parallel and vector computing; Austin, TX, USA (17 Oct 1988).

In this paper the direct solution of sparse linear systems on multiprocessor systems is considered. Elimination trees are used as a tool for identifying and exploiting parallelism in the parallel numerical factorization of the coefficient matrix. Some open problems are described and results of some numerical experiments are provided. 40 refs., 6 figs., 5 tabs.

16859 (DTH-DCAMM—368, pp 18-23) **Parametric sensitivity in first order reliability analysis.** Bjerager, P.; Krenk, S. Dec 1987. Available on loan from Risoe Library, DK-4000 Roskilde.

In Two papers in structural reliability analysis.

The parametric sensitivity of the most likely failure point as known in first order reliability analysis is studied. A formula is established for the derivative of the unit normal vector to the failure surface in this point. Also the derivative of the first order reliability index is a result of the analysis, and a geometrical imterpretation of the result is given. The derivatives have important applications in structural system reliability and outcrossing analysis. An example illustrates the results.

16860 (IAEA-TC—560.02, pp 131-135) **Progress report on independent RELAP5/MOD1 transfer to VAX-750 at Jozef Stefan Institute.** Gregoric, M.; Janezic, K.; Parzer, I. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88705332/JAW. (CONF-8705361—).

From Technical committee/workshop on computer aided safety analysis; Warsaw, Poland (25 May 1987).

During the installation of RELAP5/MOD1/CY008 code on VAX-11/750 the differences between FORTRAN on IBM and VAX were studied. The main problem to solve was how to correctly rewrite assembler routines which simulate bit packing and unpacking operations and 60-bit arithmetics on CDC. Also we faced the problem of differences in architecture between IBM and VAX. Bytes in an 8-byte word are in reversed order on VAX as on IBM. Then the INP package for reading data from data file into memory and FTB package for dynamic allocation of memory were studied. We went through 'R' and 'I' level of input processing and studied the logic of RELAP's input checking. Some basic sample problems were ran through input processing and answers compared to those from RELAP5/MOD1/CY008 and /CY029 which are installed on IBM and Cyber-173 machines in Ljubljana. Only the differences due to the lower cycle we were installing and of course due to speed of the mentioned computers occurred. Our work on installation of input processing subroutines is satisfactorily completed and we are preparing for further installation of transient, restart and strip part of code. (author). 5 refs, 3 figs.

16861 (INIS-SU—64, pp 61-62) **Abstract of the PADE2 program.** Badikov, S.A.; Gaj, E.V.; Rabotnov, N.S. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The PADE2 program (PL-1, FORTRAN, ES-1060 computer) for one-dimensional rational approximation of experimental data by the discrete optimization method is described. Covariant matrix of parameter errors and approximators of mean-square-root errors are calculated. 7 refs.

16862 (IT—1986, pp 15) **Vector and parallel processing in the petroleum industry.** Dayton, D.B.; Kobos, A.M.; Walker, M.A. (Myrias Research Corp., Edmonton, Alta.). 1986. Infotech, Ste. 200 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

This paper discusses the major applications of vector processing computers in the petroleum industry. It is concluded that the application of advanced computer architectures and technologies in areas such as seismic exploration and advanced petroleum reservoir simulation has been extensive and quite successful. Also indicated are some of the new trends in seismic modeling and petroleum reservoir modeling. In both cases, it appears to be necessary to employ model formulations which provide for a more comprehensive physical description of the processes being investigated. Techniques enabling more accurate mathematical and numerical solutions to be obtained will have to be used. New developments in computer design are examined, in particular the recent advances aiming at massively parallel computers. Examples are shown of how these new architectures will address the problem of computational complexity versus accuracy in petroleum applications. The major advantage offered by the advent of massively parallel computers over the vector processing computers will be that a greater variety of new mathematical and numerical algorithms can effectively be used. This advantage will lead to affordability of increased accuracy of solutions to many problems of great economic importance to the petroleum industry. 39 refs.

16863 (IT—1986, pp 10) **Canada's challanges in computer age technology.** Allen, T.S. (Control Data Canada Ltd.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2p8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

Trends in computing and computer technology in Canada are outlined from the point of view of a multinational company involved in the Canadian computer industry. The Canadian industry is seen as relatively weak and vulnerable to foreign competition, with little research being done in Canada and no Canadian facilities for manufacturing microchips. Dependence on the computer, however, is strong in such sectors as the petroleum industry. Recommendations are made for the future direction of computers in Canada, including industry cooperation to develop base computer technologies, development of chip production capability, considering as a matter of policy the strategic importance of the computer industry, and increasing research and development.

16864 (IT—1986, pp 11) **Evaluation of software.** Evans, D.R. (The Lennox Partnership). 1986. Infotech, Ste. 200 1015 Centre St., N., Calgary, Alta., Canada T2E 29P; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

A methodology is presented for evaluating software for use in business and industry. Discussion is made of the steps of: analysis of the current situation of the organization intending to use the software; establishing an evaulation team; defining the functional requirements of the software; deciding policies such as data processing staffing and integration with existing hardware; identification of software alternatives in keeping with the organization's requirements; development of a complete set of selection criteria; ranking the criteria; detailed examination of the software alternatives according to the criteria; making requests for proposals to suppliers; detailed supplier investigation; use of test cases; final selection; and contractual considerations. After the evaluation and selection process, it is recommended to implement the software package gradually in order to accommodate the fitting of the software system to the organization's procedures and staff learning curves.

16865 (LA-UR—88-3669) **A software model for simulation in computer-based training.** Spangenberg, L.M.; Nonno, L.M.; De Vries, J.A. II. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-890344—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003469/JAW.

From Conference on technology in training and education; Atlanta, GA, USA (1 Mar 1989).

This paper explores the requirements for Simulation-Based Training (SBT) and describes the Los Alamos model for an SBT authoring system. Although the use of simulation as an instructional strategy provides realistic training opportunities at high cognitive levels (e.g., evaluation, synthesis, analysis), it is at the expense of complexity beyond the capabilities of available authoring systems to create. Cognitive Systems Engineering (CSE) at Los Alamos is exploring a middle ground between conventional CBT and complex simulations. The CSE model proposes the separation of simulation and courseware as the key to successful SBT development. 1 ref., 2 figs.

16866 (LA-UR—88-3827) **A local area network diagnostic assistant expert system.** Mniszewski, S.M.; Peter, E.A.; Lloyd, S.C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-890304—14). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003575/JAW.

From 3. topical meeting on robotics and remote systems; Charleston, SC, United States (13 Mar 1989).

We are currently developing a stand-alone Local Area Network (LAN) Diagnostic Assistant expert system to assist system managers in diagnosing network-related hardware and software malfunctions. The goal of this system is to aid in identifying malfunctions associated with a single workstation, a group of workstations, communications between workstations, and general statements of the "Ethernet not working" type of problems. The system consists of a geographical editor for data entry and modification of LAN information and a diagnostic environment for solving problems. Much work has been done in laying the initial framework for the system in the areas of LAN representation, the problem-solving strategy, and the user interface. We used a hierarchical frame-based representation for the LAN. Information for the strategy mechanism was gathered through case studies and background information. Ideas from heuristic classification were incorporated into the strategy mechanism. As in any system development, a majority of the time was spent developing a good user interface. We used graphics renditions wherever natural and minimized keyboard input by using mouse-selectable buttons and menus. Currently, a prototype version of the system is available that assists with some single-workstation problems. 7 refs., 10 figs.

16867 (LA-UR—88-3926) **Statistical properties of cellular automata in the context of learning and recognition: Part 1, Introduction.** Gutowitz, H.A. (Los Alamos National Lab., NM (USA)). 17 Nov 1988. Contract W-7405-ENG-36. 24p. (CONF-8809268—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005446/JAW.

From Conference on learning and recognition - a modern approach; Beijing, China (1 Sep 1988).

In this lecture the map from a cellular automaton to a sequence of analytical approximations called the local structure theory is described. Connections are drawn between cellular automata and neural network models. It is suggested that the process by which a cellular automaton holds particular probability measures invariant is an appropriate model for biological memory. 20 figs.

16868 (LA-UR—88-3927) **Statistical properties of cellular automata in the context of learning and recognition: Part 2, inverting local structure theory equations to find cellular automata with specified properties.** Gutowitz, H.A. (Los Alamos National Lab., NM (USA)). 18 Nov 1988. Contract W-7405-ENG-36. 25p. (CONF-8809268—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005447/JAW.

From Conference on learning and recognition - a modern approach; Beijing, China (1 Sep 1988).

This is the second of two lectures. In the first lecture the map from a cellular automaton to a sequence of analytical approximations called the local structure theory was described. In this lecture the inverse map from approximation to the class of cellular automata approximated is constructed. The key matter is formatting the local structure theory equations in terms of block probability estimates weighted by coefficients. The inverse mapping relies on this format. Each possible assignment of values to the coefficients defines a class of automata with related statistical properties. It is suggested that these coefficients serve to smoothly parameterize the space of cellular automata. By varying the values of the parameters a cellular automaton network may be designed so that it has a spec-

ified invariant measure. If an invariant measure is considered a "memory" of the network, then this variation of parameters to specify the invariant measure must be considered "learning." It is important to note that in this view learning is not the storage of patterns in a network, but rather the tailoring of the dynamics of a network. 7 figs.

16869 **(M—221-4) COG: A particle transport code designed to solve the Boltzmann equation for deep-penetration (shielding) problems: Benchmark problems: Volume 4.** Wilcox, T.P. Jr.; Lent, E.M. (Lawrence Livermore National Lab., CA (USA)). 2 Dec 1988. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006084/JAW.

COG is a Monte Carlo computer code designed to solve the Boltzmann equation for transporting neutrons and photons and in future versions, charged particles. Sixty-four different problems were run using the current versions of the COG code on Cray-1 and Cray/X-MP computers. In all cases, the calculated COG results either agree with the values known analytically for some problems or are within the statistical and uncertainties determined experimentally for the others. Problems such as these are referred to benchmark problems and form an important part of the validation of any new computer code. Benchmark problems are of value in that they are used to: check that the code works correctly; check that the physical data used in the code are correct; check that the user has learned to run the code properly; and understand the inherent errors associated with the calculated results. 22 refs., 21 figs., 10 tabs.

16870 **(PB—89-128805/XAB) Some experiments on partitioning big sparse graphs.** Tuomela, J. (Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics). Aug 1988. 15p. (MAT-A—258). NTIS, PC E03/MF A01.

When solving large systems of differential equations one could decompose the system into smaller subsystems and solve them in parallel. This report sets up a model for the partitioning problem using graphs, so the problem becomes a combinatorial optimization problem. It uses the simulated annealing method to solve the problem and give the numerical results obtained.

16871 **(SAND—86-2059) An algorithm for automated quadrilateral mesh generation for planar regions.** Koteras, J.R.; Selleck, C.B.; Jones, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007299/JAW.

This paper describes an algorithm which will automatically generate an all quadrilateral mesh for planar regions with material interfaces. The algorithm uses an interior quadtree approximation of the region to be meshed as the basis for the mesh generation. Once the interior quadtree is generated, a layer of elements is generated between the interior quadtree boundary and the boundary of the planar region. Smoothing techniques are then used to produce well shaped elements throughout the object. This procedure has been implemented in a code and examples of meshes produced with this approach are shown. The algorithm described here provides a basis for an automated mesh generator which will produce all hexahedral meshes for three-dimensional solids. 10 refs., 9 figs.

16872 **(SAND—88-1862) Instant prototyping using HyperCard{reg←sign} on the Macintosh{reg←sign}.** Miller, D.P. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007058/JAW.

Rapid interface prototyping (RIP) involves the simulation of potential user-interface designs for demonstrating and evaluating design concepts and iteratively modifying the interface designs without the burden of labor-intensive code generation and modification. In the past few years, many interface designers have had to use expensive equipment to help them perform RIP. Well, thanks to Bill Atkinson and the folks at Apple Computer Inc., you can purchase HyperCard software for your Macintosh for $49 and use it right out of the box for many of your RIP projects, without need of additional hardware (just add a cup of creativity). A special feature of HyperCard allows the designer to create software-controlled buttons which, along with the graphics capabilities and the layering properties, permit the dynamic simulation of virtually any control panel that can be operated by discrete user inputs. Changes to the prototype can be made very rapidly (almost instantly) by an experienced HyperCard user, making it possible to modify an existing prototype "on-line" in a design meeting. This report will describe this serendipitous application of HyperCard, its potential as an equipment-interface design tool, and describe how it was used to simulate the user interface for a weapons field tester, designed at Sandia. 5 refs., 3 figs.

16873 **(SAND—88-3122) Auger electron and x-ray photoelectron data processing for the personal computer.** Mott, P.W. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007292/JAW.

A low cost Auger electron spectroscopy (AES)/X-ray photoelectron spectroscopy (XPS) data processing system for IBM compatible personal computers is described. The system has been designed to interface with most computer controlled electron spectrometers. The data system is based on a large software package named PC←ACSES (Personal Computer Analysis Code for Scanning Electron Spectrometers). This software utilizes a mouse driven interface and provides the user with a wide range of easily accessible data processing options. Features of the system include data manipulation, manual and automatic quantification, flexible annotation and high quality plotter output. In addition, the system can incorporate a 512 x 512 image framestore and powerful digital image processing routines. The image processing capabilities of PC←ACSES allow the user to optimize both secondary electron (SEM) and elemental images, add color to images with histogram painting, create customized pseudo-color image overlays, and annotate images with variable size fonts and micron markers. This PC (personal computer) based data processing system provides a low cost alternative to high-end commercial systems by combining inexpensive computer hardware with advanced software. 6 refs., 5 figs.

16874 **(SAND—88-3128) Eps'88: Combining the best features of von Neumann and dataflow computing.** Grafe, V.G.; Hoch, J.E.; Davidson, G.S. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007291/JAW.

A new parallel architecture is presented which combines the beneficial features of both dataflow and von Neumann computers. Dynamic exploitation of parallelism is supported by a direct match dataflow scheduling mechanism. The dataflow scheduling mechanism can be applied to individual instructions or to groups of instructions. These groups of instructions are executed in a predetermined order, as in von Neumann machines. This deterministic scheduling allows the reuse of data through common memory locations and the use of local state (registers) to minimize resource requirements and latency. The foundation of this architecture includes single clock, direct matching of operands, dynamically allocated frame-based data storage, and a general repeat function that can dispatch instructions in a predetermined order. The ability to execute fully and partially ordered instruction streams makes the architecture amenable to both imperative and functional languages. The operation of the processor architecture, the associated structured memory system, proposed interconnections, and programming considerations are described. The entire architecture has been captured in a functional simulator, and hardware implementations of several of the vital parts are underway. 7 refs., 17 figs.

16875 **(SAND—88-3197) An analysis of script execution time variability on the Sandia National Laboratories CRAY computing systems.** Benson, M.J. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007531/JAW.

An analysis of variability in test script execution time was performed using the Shewhart Control Chart Method. These charts show that the CRAY systems are not in control with respect to test

script execution times. However, when one analyzes the performance of specific tasks within the test script, the situation is improved. It was concluded that the test script itself is not a controlled process because it is the superposition of several distinct distributions and that existing data do not form the basis for a simple method of performance monitoring. Suggestions are made regarding future actions which might lead to the desired result. 3 refs.

16876 **(SAND—88-3363C) A structural analysis algorithm for massively parallel computers.** Benner, R.E.; Montry, G.R.; Gustafson, J.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 11p. (CONF-8810280—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005055/JAW.

From Workshop on methods and algorithms for PDE's on advance processors; Austin, TX, USA (17 Oct 1988).

We describe a high performance parallel algorithm based on the conjugate gradient method for large structural analysis problems. The algorithm has been tested on a 1024-processor hypercube. Three performance models are measured: 1024-processor speedup is 502 when problem size is fixed, 987 when execution time is fixed, and 1019 when problem size per processor is fixed. The latter two models best show the practical capabilities of large ensembles. Sustained performance is 132 MFLOPS (64-bit), matching or surpassing performance of more conventional processing methods. Measurements show the techniques will extend to even higher levels of parallelism than the 1024-processor level explored here. 11 refs., 3 figs., 4 tabs.

16877 **(SLAC-PUB—4798) Scalable coherent interface.** Gustavson, D.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1988. Contract AC03-76SF00515. 3p. (CONF-890229—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006067/JAW.

From CompCon Spring '89: Institute for Electrical and Electronics Engineers (IEEE) Computer Society meeting; San Francisco, CA, USA (27 Feb 1989).

The Scalable Coherent Interface project (formerly known as SuperBus) is based on experience gained during the development of Fastbus (IEEE 960), Futurebus (IEEE 896.1) and other modern 32-bit buses. SCI goals include a minimum bandwidth of 1 GByte/sec per processor; efficient support of a coherent distributed-cache image of shared memory; and support for segmentation, bus repeaters and general switched interconnections like Banyan, Omega, or full crossbars. SCI abandons the immediate handshake characteristic of the present generation of buses in favor of a packet-based protocol. SCI avoids wire-ORs, broadcasts, and even ordinary passive bus structures, except that a lower performance (1 GByte/sec per backplane instead of per processor) implementation using a register insertion ring architecture on a passive "backplane" appears to be possible using the same interface as for the more costly switch networks. This paper presents a summary of current directions, and reports the status of the work in progress.

16878 **(SOL—88-3) Inertia-controlling methods for quadratic programming.** Gill, P.E.; Murray, W.; Saunders, M.A.; Wright, M.H. (Stanford Univ., CA (USA). Systems Optimization Lab.). Nov 1988. Contract FG03-87ER25030. 40p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006996/JAW.

Active-set quadratic programming (QP) methods use a working set to define the search direction and multiplier estimates. In the method proposed by Fletcher in 1971, and in several subsequent mathematically equivalent methods, the working set is chosen to control the inertia of the reduced Hessian, which is never permitted to have more than one nonpositive eigenvalue. (We call such methods inertia-controlling). This paper presents an overview of a generic inertia-controlling QP method, including the equations satisfied by the search direction when the reduced Hessian is positive definite, singular and indefinite. Recurrence relations are derived that define the search direction and Lagrange multiplier vector through equations related to the Karush-Kuhn-Tucker system. We also discuss connections with inertia-controlling methods that maintain an explicit factorization of the reduced Hessian matrix. 35 refs., 5 figs.

16879 **(SOL—88-21) A parallel decomposition algorithm for Staircase Linear Programs.** Entriken, R. (Stanford Univ., CA (USA). Systems Optimization Lab.). Dec 1988. Contract FG03-87ER25028;AC05-84OR21400. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007023/JAW.

As part of an extended research project on the parallel decomposition of linear programs, a parallel algorithm for Staircase Linear Programs was designed and implemented. This class of problems encompasses a large range of planning problems and when decomposed has simple subproblem formulations and communication patterns. This makes its solution a manageable step toward our eventual goal of producing a general code that automatically exploits problem structures of various forms. The results presented here were derived from an implementation for a Sequent Balance 8000 shared-memory multiprocessor. The algorithm itself is message-based but can run on either shared- or distributed-memory parallel computers. A simple diet planning problem is used to demonstrate the principles of the algorithm's development and performance. When applied to this problem, the parallel decomposition algorithm shows promise relative to present serial optimization codes. The nonlinear optimization code MINOS 5.1 is used both as a basis for comparison and as a generic subproblem solver. The greatest room for speedup is in exploiting problem structures. The results show that decomposition can improve efficiency even with a single processor. Examples are given where multiple processors lead to still greater efficiency. 9 refs., 12 figs., 4 tabs.

16880 **(UCID—21011-Vol6.Rev.1) Installation/user's guide version 1.1 for DOEDEF Translator Module Pool A: Revision 1.** Wimple, C. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1987. Contract W-7405-ENG-48. 103p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007549/JAW.

The Department of Energy Data Exchange Format (DOEDEF) Translator Module Pool A (hereafter referred to as the "pool") is intended to reduce the manpower required to rewrite the DOEDEF translator software already in existence throughout the Department of Energy Nuclear Weapons Complex (DOE NWC). Each portion of the DOEDEF exchange system and therefore each site's DOEDEF translator software must be rewritten during the transition from Phase 1.0 to Phase 1.5 of DOEDEF. By providing a pool, the effort required to move from Phase 1.0 to Phase 1.5 can be reduced throughout the NWC. 7 refs.

16881 **(UCID—21620) INGRID features and updates.** Rainsberger, R. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007277/JAW.

This paper discusses the INGRID computer graphics program and its updated routines. (LSP)

16882 **(UCRL—21179) Dynamic mechanical system design using qualitative and symbolic reasoning.** Kim, Young-Jin; Agogino, A.M. (Lawrence Berkeley Lab., CA (USA)). 6 Dec 1988. Contract W-7405-ENG-48. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006771/JAW.

This report describes the results of a three-month project to perform preliminary research for use in preparation of UCB Campus- LLNL collaborative research proposal. The goal of this research is to develop and implement artificial intelligence methods for the design, modeling and analysis of dynamic physical systems. Bond graphs and a library of dynamic system primitives form the basis of the knowledge representation scheme. Bond graphs abstract physical systems into basic elements that represent localized dynamic properties of small parts of the system. This research deals with mechanical systems, in which there are natural hierarchies of subsystems which are in turn comprised of primitive components. The subsystems developed in this research are divided into three classes: resistance fields, inertial fields and capacitance fields. Basic categories from the mechanical systems domain are examined to derive the characteristics of each subsystem. We propose that future research begin with the development of a library of natural modeling

primitives for physical subsystems along with rules for creating a network from such primitives. We modify Karnopp and Rosenberg's mechanical translation construction method to generate the automatic bond graph representation of mechanical system in a rule/frame-based format. We outline a knowledge-based methodology to define a bond graph description of complex dynamic physical systems from an integration of simpler primitives and component classes. We conclude with a framework for integrating earlier work in predicting and directing the behavior of dynamic systems using qualitative and symbolic reasoning for providing a mathematical description of the behavior of the system along with recommendations concerning the design parameters. 7 refs., 2 figs.

16883 **(UCRL—98289) An automatically partitioning compiler for SISAL.** Sarkar, V.; Skedzielewski, S.; Miller, P. (Lawrence Livermore National Lab., CA (USA)). 20 Dec 1988. Contract W-7405-ENG-48. 10p. (CONF-880975—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006738/JAW.

From CONPAR '88; Manchester, UK (12 Sep 1988).

In this paper, we describe a compiler that automatically repackages SISAL programs to achieve the grain size needed to run efficiently on different multiprocessors. The compiler is based on an existing implementation for SISAL on the Sequent Balance multiprocessor, and on previous work on automatic partitioning of SISAL programs. The granularity of parallelism in the existing Sequent implementation is defined by language constructs (e.g., all function calls are spawned as separate tasks), causing the programming style to dramatically effect multiprocessor performance. It is desirable for the partitioning to be performed automatically, so that the same program can be made to execute efficiently on different multiprocessors and the programmer need not be concerned with granularity issues when developing his program. This is the goal of our automatically partitioning compiler. The partitioner operates on IF1, a graphical intermediate language for SISAL programs. It also takes as input a list of parameters describing the target multiprocessor. The partitioner's output consists of IF1 annotations to specify which calls to user-defined functions should be executed as parallel tasks, which Forall expressions should be executed as parallel loops and their appropriate chunk sizes. the Sequent Balance implementation has been retargetted to the Alliant, multi-VAX and Cray X-MP multiprocessor systems. It is currently being modified to support the partitioner's output, rather than just using the default granularity. We intend to use the automatically partitioning compiler to study the performance of various SISAL application programs on these different multiprocessors. 11 refs., 8 tabs.

16884 **(UCRL—98708) Tomographic image reconstruction using systolic array algorithms.** Azevedo, S.G.; DeGroot, A.J.; Schneberk, D.J.; Brase, J.M.; Martz, H.E.; Jain, A.K.; Current, K.W.; Hurst, P.J. (Lawrence Livermore National Lab., CA (USA)). 22 Dec 1988. Contract W-7405-ENG-48. 12p. (CONF-8808123—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006153/JAW.

From Conference on review of progress in quantitative NDE; La Jolla, CA, USA (1 Aug 1988).

Image reconstruction for Computed Tomography (CT) is a time consuming operation on current uniprocessor computers and even on array processors. This is particularly true for three-dimensional data sets or for limited-data reconstructions requiring iterative procedures. In these cases, the projection operation (Radon transform) and its inverse (filtered back-projection) are major computational tasks that are performed many times. Multiprocessor computers, especially in systolic array configurations, can provide dramatic improvements in reconstruction times at reasonable costs. An in-house systolic processor, called SPRINT, has been programmed to demonstrate these improved speeds while achieving near 100% efficiency of all processor elements. We report on these results in this paper. In addition, two proposed hardware implementations of a new architecture are shown to have even greater speed-up possibilities. One, using standard DSP chips, has been simulated to give a factor of three improvement over SPRINT, while the other, using custom VLSI that is now in the early stages of design, could potentially perform 512^2 reconstructions at video rates (100 times further speedup). These processors are also interconnected in a systolic array configuration. Experimental and projected results, with future plans, are also reported in this paper. 11 refs., 5 figs., 1 tab.

16885 **(UCRL—98826) Software engineering in Asia: A report on the 10th International Conference on Software Engineering, April 11--16, 1988, Singapore: [Foreign trip report].** Zucconi, L. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006783/JAW.

The complete trip report describes my impressions of the 10th International Conference on Software Engineering held in Singapore in April, 1988. I attended Tom DeMarco's and Tim Lister's tutorial on Software Productivity: The Human Side, Barry Boehm's tutorial on Software Risk Management, and the conference, where I focused on the panel sessions. I attended paper sessions for topics that appeared of particular interest. On Saturday the 16th I participated in site visits to the Singapore National Computer Board's Information Technology Institute and the National University of Singapore's Institute of System Science. Since the conference was in Southeast Asia and was attended mostly by Asians (about 700 attendees and only 100 or so from North America and Europe), its focus was very much on software engineering and software technology in Asia. It was crystal clear that Japan is the leader and is assisting less advantaged countries such as Singapore, China, Malaysia, Philippines and India to develop their software industries. Japan dominates Asia technically and economically.

16886 **(UCRL—98827) Software reliability engineering.** Lawrence, J.D. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 16p. (CONF-880894—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006781/JAW.

From Structured development forum X; San Francisco, CA, USA (8 Aug 1988).

There are cases in which a computer system failure can have a serious impact on human life and health, property, and finances. This paper argues that structured development, for such systems, must give serious consideration to reliability and safety of both the computer system and the more general system which the computer is controlling. Activities can be carried out during the system life cycle which can improve reliability and safety. After a general discussion of software reliability engineering, the paper gives specific suggestions for activities during the requirements analysis and design phases of the life cycle. 18 refs.

16887 **(UCRL—100195) A SLAP [Sparse Linear Algebra Package] for the masses.** Seager, M.K. (Lawrence Livermore National Lab., CA (USA)). 12 Dec 1988. Contract W-7405-ENG-48. 17p. (CONF-8810280—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006209/JAW.

From Workshop on methods and algorithms for PDE's on advance processors; Austin, TX, USA (17 Oct 1988).

A Sparse Linear Algebra Package (SLAP), written in FORTRAN77, for the iterative solution of large sparse symmetric and non-symmetric linear systems is presented. SLAP Version 2.0 consists of three levels of routines: "high level", "core" and "utility." The "core" routines implement the following preconditioned iterative methods: iterative refinement, conjugate gradient, conjugate gradient on the normal equations, bi-conjugate gradient, bi-conjugate gradient squared, orthomin and generalized minimum residual. All of these methods do not require the data structure of the matrix being solved nor of the preconditioning matrix, but do require the "user" to supply a matrix vector product and preconditioning routines. The "high level" routines assume one of two specific data structures and provide the required "user routines." The preconditioners supported are diagonal scaling and incomplete factorization. One of the SLAP data structures allows for the vectorization of the matrix multiply and the backsolve of the incomplete factorization operations on machines with hardware gather/scatter capabilities. We present results for SLAP on the Cray Y/MP and Alliant FX/8 machines. 10 refs., 3 figs., 10 tabs.

16888 **(X-EP-CM-RA—1985) Annual report of the Mathematics Center, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 11p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756693/JAW.

A bibliography of around 60 references concerning research in mathematics is presented.

16889 **(X-EP-CM-RA—1986) Annual report of the Center for Mathematics.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 25p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756694/JAW.

Research on partial differential equations; representation and cohomology of topological and Lie groups; singularities; dynamical systems; and Riemann geometry and global analysis is presented.

16890 **(X-EP-CMA-RA—1985) Annual report of the Center for Applied Mathematics, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 23p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756695/JAW.

Research on the mathematical aspects of wave propagation; particulate methods in fluid physics and mechanics; nonlinear problems; stochastic equations; martingales, and interacting particle systems; and computer programming and algorithms is presented.

16891 **(X-EP-CMA-RA—1986) Annual report of the Center for Applied Mathematics, 1986.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1987. 35p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756696/JAW.

Research on the mathematical aspects of wave propagation; particulate methods in fluid physics and mechanics; nonlinear problems; stochastic equations; martingales, and interacting particle systems; and computer programming and algorithms is presented.

16892 **Nanosequencer digital logic controller.** Lahmeyer, C.R. (to US National Aeronautics and Space Administration, Washington, DC). US Patent 4,766,533. 23 Aug 1988. Filed date 5 Jan 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a logic controller receiving status line inputs with status states thereof defining conditional instructions to the logic controller and having a single memory access time to access an instruction having a fixed duration instruction execution time. The controller consists of: a memory means having address lines for storing instructions and providing first output lines, the memory having segments associated with the status of the plurality of status line inputs and having stored therein instructions for application to the first output lines with each instruction including separate bit sequences for controlling logic control, status select, and next address lines; register means connected to and supplied by the first output lines for receiving an instruction from the memory means and providing the instruction on a second output lines, the output lines including logic control, status select, and next address lines for respectively emitting the bit sequences received from the memory means thereat; means connecting the next address lines of the second output lines from the register means to the address lines of the memory means; status control selection means connected to receive status line inputs and connected to and controlled by the status select lines of the second output lines for selection, once each instruction execution time, one status line input from among the status line inputs based upon the bit sequence emitted by the register means at the status select lines.

16893 **Parallel architectures for vision.** Maresca, M. (Dist-Univ. of Genova, 16145 Genova (IT)); Lavin, M.A. (Thomas J. Watson Research Center, IBM, Yorktown Heights, NY (US)); Li, H. (IBM Almaden Research Center, San Jose, CA (US));. *Proceedings of the IEEE (Institute of Electrical and Electronics Engineers);* **76**: No. 8, 970-981(Aug 1988).

Vision computing involves the execution of a large number of operations on large sets of structured data. Sequential computers cannot achieve the speed required by most of the current applications and therefore parallel architectural solutions have to be explored. In this paper the authors examine the options that drive the design of a vision oriented computer, starting with the analysis of the basic vision computation and communication requirements. They briefly review the classical taxonomy for parallel computers, based on the multiplicity of the instruction and data stream, and apply a recently proposed criterion, the degree of autonomy of each processor, to further classify fine-grain SIMD massively parallel computers. They identify three types of processor autonomy, namely operation autonomy, addressing autonomy, and connection autonomy. For each type they give the basic definitions and show some examples. They focus on the concept of connection autonomy, which they believe is a key point in the development of massively parallel architectures for vision. They show two examples of parallel computers featuring different types of connection autonomy - the Connection Machine and the Polymorphic-Torus - and compare their cost and benefit.

16894 **Rotating thermal convection.** Magnan, J.F.; Reiss, E.L. (Dept. of Mathematics, Florida State Univ., Tallahassee, FL (US));. *SIAM Journal on Applied Mathemadics;* **48**: No. 4, 808-827(Aug 1988).

This paper consider the secondary and cascading bifurcation of two-dimensional steady and period thermal convection states in a rotating box. Previously developed asymptotic and perturbation methods that rely on the coalescence of two, steady convection, primary bifurcation points of the conduction state as the Taylor number approaches a critical value are employed. A multitime analysis is employed to construct asymptotic expansions of the solutions of the initial-boundary value problem for the Boussinesq theory. The small parameter in the expansion is proportional to the deviation of the Taylor number from its critical value. To leading order, the asymptotic expansion of the solution involves the mode amplitudes of the two interacting steady convection states. The asymptotic analysis yields a first-order system of two coupled ordinary differential equations for the slow-time evolution of these amplitudes. The authors investigate the steady states of these amplitude equations and their linearized stability.

16895 **Multiprocessor schemes for solving block tridiagonal linear systems.** Berry, M.W.; Sameh, A. (Univ. of Illinois at Urbana-Champaign, Urbana, IL (US));. *International Journal of Supercomputer Application;* **2**: No. 3, 37-57(1988).

The solution of large, banded diagonally dominant or symmetric positive definite linear systems constitutes one of the most common computational tasks associated with implementations of the finite element method in applications such as fluid dynamics and structural analysis. Thus, designing multiprocessor algorithms for solving large block tridiagonal systems becomes of paramount importance for efficient implementation of these applications on vector and parallel machines. The authors present such schemes here, along with specific performance results on the Alliant FX/8 and CRAY X-MP 48. They particularly emphasize the speedups obtained with these schemes over popular direct band solvers. The development of a candidate scheme for the multicluster CEDAR machine is their goal.

16896 **Concurrent neuromorphic algorithms for optimization of the computational load of a hypercube supercomputer.** Barhen, J.; Toomarian, N.; Protopopescu, V.; Clinard, M. (Oak Ridge National Lab., Oak Ridge, TN (US));. pp v of Proceedings of the IEEE first international conference on neural networks. Volumes 1-4. Caudill, M.; Butler, C. Piscataway, NJ; IEEE Service Center (1987). (CONF-8706130—).

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

A novel approach toward the optimization of the time-dependent computational load in message-passing multiprocessor systems is presented. Compact neuromorphic data structures are used to model effects such as precedence constraints, processor idling time and task-schedule overlap. Analytic expressions are given for the effect of single-neuron perturbations on the systems' configuration energy. Algorithms for the implementation of this methodology on a hypercube supercomputer are outlined along with potential extensions to large-scale nonlinear asynchronous neural networks.

16897 **Darwinian optimization of synthetic neural systems.** Dress, W.B. (Oak Ridge National Lab., Instrumentation and Controls Div., Oak Ridge, TN (US));. pp v of Proceedings of the IEEE first international conference on neural networks. Volumes 1-4. Caudill, M.; Butler, C. Piscataway, NJ; IEEE Service Center (1987). (CONF-8706130—).

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

This paper suggests a synthesis of computer science and artificial intelligence with the resurgent ideas of artificial neural systems and genetic algorithms cast in a classical Darwinian mold. Just as Darwin's original theory avoided the need for teleological arguments, the thrust of the approach set forth here for synthetic systems avoids the problem of programmer omniscience and the resulting brittle programs for precisely the same reasons. The price to be paid is one of many long computations on, perhaps, many parallel processors. Hardware development leading to parallel networks of RISC processors should meet the near-term needs of evolutionary parameter determination and allow the ensuing synthetic systems to function in real-time for certain tasks. In the longer term, special-purpose devices will be needed.

9903 Information Handling

REFER ALSO TO CITATION(S) 14300, 15030, 16019, 16407

16898 (IT—1986, pp 4) **The use of computer technology to disseminate inforamtion.** Jones, P.D. (Merland Exploration Ltd.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

Merland Explorations and North Canadian Oils, based in Calgary, have experienced growth in their information services. The roles and functions of their information service departments are presented in outline form. Mention is made of the role of end users, the dissemination of information by hard copy vs online reporting, the use of personal computers as opposed to mainframes, database integration, office automation, graphic vs numerical reporting, security, remote data collection, and cost effectiveness of systems. 1 fig.

16899 (IT—1986, pp 2) **The use of computer technology to disseminate information.** Schultz, J.A. (Home Oil Co. Ltd.). 1986. Infotech, Ste. 200 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

Home Oil, a medium sized Canadian oil and gas company, has gone through a major redevelopment phase of its computer system, with the major emphasis on development of online corporate database systems. Integrated information systems are also seen as a beneficial part of this redevelopment. Progress is being made in reducing the volume of paper generated within the company, in the gradual use of personal computers within the system largely based on mainframes, in development of data acquisition from remote sites, in the linking up of departmental databases to provide increased database integration, and to provide better security to confidential data, end-user training, and increased office automation.

16900 (IT—1986, pp 6) **The use of computer technoiogy to disseminate information.** Colling, D. (Coporate Systems & Services). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

The experience of Petro-Canada, a nationally oriented and fully integrated oil major company, with computerized information systems is presented in outline form. This outline includes information on hardware, software, graphics and numerical capabilities, communications capabilities, access and security, end-user training, office automation, databases, and impact areas of this technology. Four impact areas are mentioned: electronic mail/office automation, point of sale/bulk plant automation, personal computers installed on drilling ships, and the graphics software/resources technical system.

16901 (IT—1986, pp 5) **Optical disk application for today's petroleum industry.** Irving, G. (Instar Corp., Calgary, Alta.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

In the petroleum industry, exploration is probably the most demanding in terms of information handling. It is being found that magnetic tape, the major information handling medium, is no longer the ideal storage technology. Huge data volumes, online/random access, and increased recording speeds have exceeded the capabilities of tape. This paper discusses the application of optical disk technology according to two categories: the replacement of tape with optical disks in existing systems, and the redesign of existing systems, or building new systems, that make the maximum use of optical disk technology. The areas of data collection, interpretation, and archiving are examined to see how that technology can be applied. A review of optical disk applications within the petroleum industry shows that most of these applications are experimental, but larger scale use will start this year. Interest in the technology from within the industry is due to the current and future demands on information systems. But it is important to realize optical disks will not replace magnetic technology for three main reasons: the write-once-only feature of the current technology prevents direct replacement; magnetic technology is still developing and costs are dropping; and the sheer amount of information currently stored on magnetic medium prevents any rapid switch to optical disk. In the short term, data archiving and interpretation appear to be most in need of optical technology. As for the future, new information systems which include expert systems and very large databases will probably incorporate optical technology.

16902 (IT—1986, pp 7) **Online production accounting systems.** Shumlich, L. (XI Consultants Ltd.). 1986. Infotech, Ste. 200, 1015 Centre ST., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

The capabilities and requirements of online production accounting systems for the petroleum industry are presented in outline form. The traditional function of such systems, i.e. reporting of production volumes, disposition volumes, and royalties, has broadened to include other functions, notably field data capture and business functions. Personal computers are mentioned as being the cost-effective choice for most applications. Recommended system features are suggested, and the ability of such systems to integrate with other parts of the organization is seen as being important.

16903 (IT—1986, pp 20) **Automated control systems at field level.** Stuart, K.R. (Esso Resources Canada Ltd.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

FPC (Field Production Control) and FOCIS (Field Operations Control and Information System) were constructed as replacement systems for the Central Production Control/Central Data Collection (CPC/CDC) system at Esso Resources Canada. CPC (real-time) functions were addressed by the FPC system and CDC (business) functions by the FOCIS system. FPC runs on six distributed Data General S/20 micro-computers serving six production areas. Existing real-time units and other field equipment were used. Functions of the FPC system include well test sequencing, pipeline leak detection, alarm monitoring, remote valve control and reading of remote status points. Functionality has recently been added to handle modicom units. FPC uses menu driven screens and soft function keys in its user interface. All data is easily accessible on the sceeen which minimizes the need for hardcopy reports. FOCIS runs on four distributed Data General Eclipse mini-comput-

ers and is currently implemented in eight production areas. Manual input into FOCIS is by an on-line, menu driven, full-screen input user interface. Function keys permit scrolling, displaying help screens, and a GO TO key allows ease of movement through the data. Data collected on the FPC system such as well test results, closing meter readings, well down hours and tank gaugings are passed automatically to FOCIS on a daily basis. FOCIS performs four major functions: collection of volumetric data for producing and injecting facilities, allocation of volumes, reporting, and a monthly feed to the corporate accounting system. 2 figs.

16904 (IT—1986, pp 26) **The new promise of executive information systems.** Kniffin, R.S. (Pilot Executive Software). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8, $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

Executive information systems, which bring together relevant data from a variety of internal and external sources and filters, compresses, and tracks critical data in order to inform managers quickly, and in a meaningful way, on matters relevant to their organizational responsibilities. The impact of new technologies related to the personal computer is assessed as the main reason for the increase in use of such systems. Advantages of such systems include cost effectiveness, local processing powers, high quality color screen images, and fast, intuitive, non-keyboard interaction devices that mean ease of use. The indivdual computing aspects of such systems are contrasted with the traditional centralized data processing aspect of corporate computing. An outline is made of how executive information systems effect decision making: they provide extremely timely information, personalize the information according to the manager's individual need, and are able to manipulate information as needed. A key part of this process is the ability of the system to align itself to the factors that are most critical to achieving the organization's objectives. The executive information system database, in fact, is defined as containing that information which supports management control of the critical success factor identification and tracking process. The system can also go beyond this and track exceptions to that process, and can integrate external data into the information base. The system developed by Pilot Executive Software is described and future trends in executive information systems are predicted. 10 figs.

16905 (IT—1986, pp 7) **Life cycle analysis.** Galloway, B. (Diamond Shamrock Exploration Co.). 1986. Infotech, Ste. 200 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

This paper presents a methodology for analyzing an information systems development project in the petroleum sector, from the prospect of the entire life cycle of such a project. The objectives of the methodology are to: provide a framework for planning, control and direction of the project by establishing strategic control points and milestones for measuring progress; provide standard definitions and descriptions of tasks required to develop a system and to ensure complete and consistent project documentation; guide project personnel; and make efficient and effective use of all project resources. The recommended phases of a systems life cycle are: the feasibility phase, where the decision whether or not to undertake a development project is undertaken; the analysis phase, wherein the system requirements are analyzed and functional requirements are prepared; the functional design phase, where specifications and technical architecture are established; the technical design phase, where the functional requirements are transformed into detailed program specifications and common modules are prepared; the implementation phase; and post-implementation stages where ongoing support is provided and enhancements are made over time. Each of these phases is examined in some detail.

16906 (IT—1986, pp 12) **The interactive interpretation environment.** Munoz, F.S.J.; Best, M. (Teknica Resource Development Ltd.). 1986. Infotech, Ste. 200, 1015 Centre St., N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN. (CONF-8602174—; CE—02139).

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

An overview is presented of the requirements for petroleum exploration data interpretation in an interactive software system setting. The objective of interpretation is to arrive at recommended drilling locations for exploration plays or to present reservoir delineation information for production drilling. Problems facing interpretation include the wide variety of data sources, increased costs, the degree of manual intervention in current interpretation methods, and the increasing sophistication of tools and techniques used. Efforts are being made to improve the interpreter's ability to interact with the data, to automate the more mundane activities involved in the interpretation, and to improve the interpreter's productivity by freeing him to focus on the creative aspects of interpretation. The qualitative and quantitative attributes of the data involved in interpretation are presented; these data include financial, land, geographical, geological, geophysical, and generated data. User requirements consisting of the ability to retrieve, compute and display those data types, are outlined along with the operational criteria of responsiveness, ease of use, and cost-effectiveness. A typical exploration scenario of seismic interpretation, geological analysis, and economic and land analysis is presented, and future trends in the interactive interpretation environment are discussed.

16907 **(IT—1986) Petroleum software.** (Info-Tech, Calgary, Alberta (Canada)). 1986. vp. (CONF-8602174—; CE—02139). Infotech, Ste. 200, 1015 Centre St.,N., Calgary, Alta., Canada T2E 2P8; $35.00 CAN.

From Petroleum software conference and exhibition; Calgary, Canada (25 Feb 1986).

A conference was held to present information on software and software implementation as it relates to the petroleum industry. The focus of the conference was on integration of information systems, with a view to promoting involvement of industry executives. Papers were presented in the areas of general criteria for evaluating software, exploration systems, financial management systems, production information systems, future computer technologies, and the use of computer technology to disseminate information. Separate abstracts have been prepared for 15 papers from this conference.

16908 **(X-EP-CI-RA—1985) Annual report of the Computing Center, 1985.** (Ecole Polytechnique, 91 - Palaiseau (France)). 1986. 801p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88756692/JAW.

The computing services and hardware of the Ecole Polytechnique are presented.

9904 Law

16909 **(IAEA-INFCIRC—167(Add.14)) Text of the regional co-operative agreement for research, development and training related to nuclear science and technology, 1987. Status of acceptances as of 15 December 1988.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1988. 1p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705455/JAW.

The document presents the status of acceptances as of 15 December 1988 of the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology, 1987.

9905 Civilian Defense

16910 **(CONF-8805250—1) Data representation and matching for events and templates.** Gabriel, J.R.; Gabriel, M.H. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005883/JAW.

From Data fusion symposium; Warminster, PA, USA (17 May 1988).

This note examines means and reasons to encode event descriptions into bit strings - or, rather, strings of decision flags taking the values TRUE, FALSE, or UNKNOWN. In the case of perfect knowledge, all flags are TRUE or FALSE. In variants of the

theory where degrees of confidence are taken into account, UNKNOWN is replaced by a value in the interval [0:1] representing the degree of confidence that the TRUE branch of the decision matches ground truth or the result of perfect knowledge. In templates, a fourth value - ARB - may be used, indicating an event attribute the same as or related to attributes of other events in the same template. We consider here the encoding of events whose place, time, and other attributes are known. Specifically we show that any set of events so encoded can be sorted to facilitate search for patterns such as troop concentrations. Templates are also sets of events with some attributes UNKNOWN and others ARB in the sense that their values are determined once the values of ARB's for other events in the template are known from matching (unification) with observed events in a history. Thus templates containing an ARB are properly speaking pattern matching algorithms, and can in principle be complex procedures. A match with an UNKNOWN attribute in a template can be TRUE or FALSE and, unlike ARB, does not propagate a value into other attributes. The possibility of linearly ordering the events in a history and perhaps in a template also enables one to search an event file for aggregates to be done by passing "windows" over the event file.

16911 **(LA—11382-MS) Impact of target altitude restrictions on laser performance.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Jan 1989. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006567/JAW.

This report estimates the impact of Raman restrictions and shielding penalties separately and together. Its goal is an overall assessment of likely impact rather than a review of the details of missile trajectories, Raman physics, and shielding techniques, whose individual treatments matter less than their overall integration. Raman scattering could produce a factor of 2-3 reduction on the performance of repetitive pulse lasers with large fluences in each small pulse. Radio-frequency free-electron lasers (RF FELs), which have more frequent pulses with less energy in each, are impacted less. Shielding gives an independent penalty of about a factor of 2, but the combined effect of altitude and shielding penalizes lasers with large pulses by factors of 3-10. Those factors are significantly larger than any other factors differentiating between the two types of FELs. 8 refs., 2 figs.